Satellite Analysis

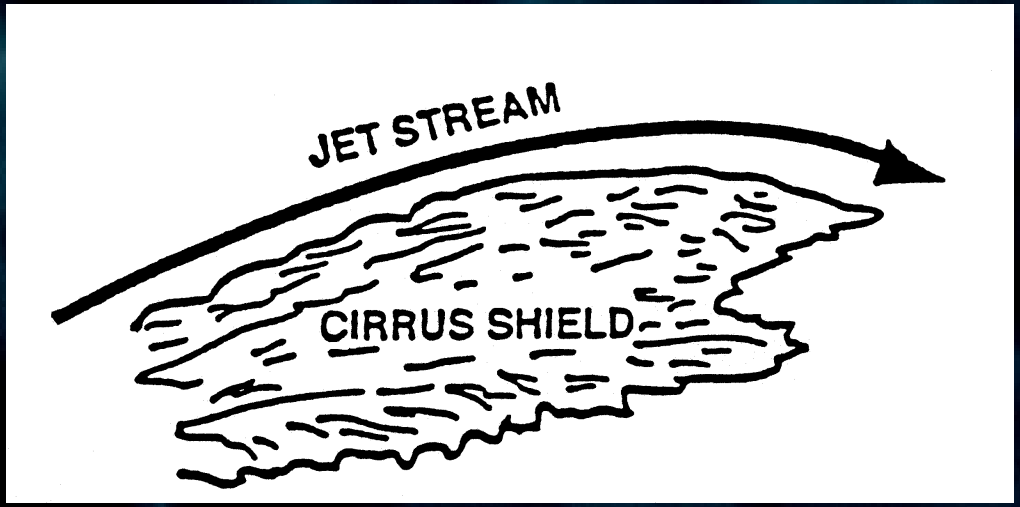
2c. Interpret weather satellite imagery to determine meteorological features.

Analysis of Upper-level Features

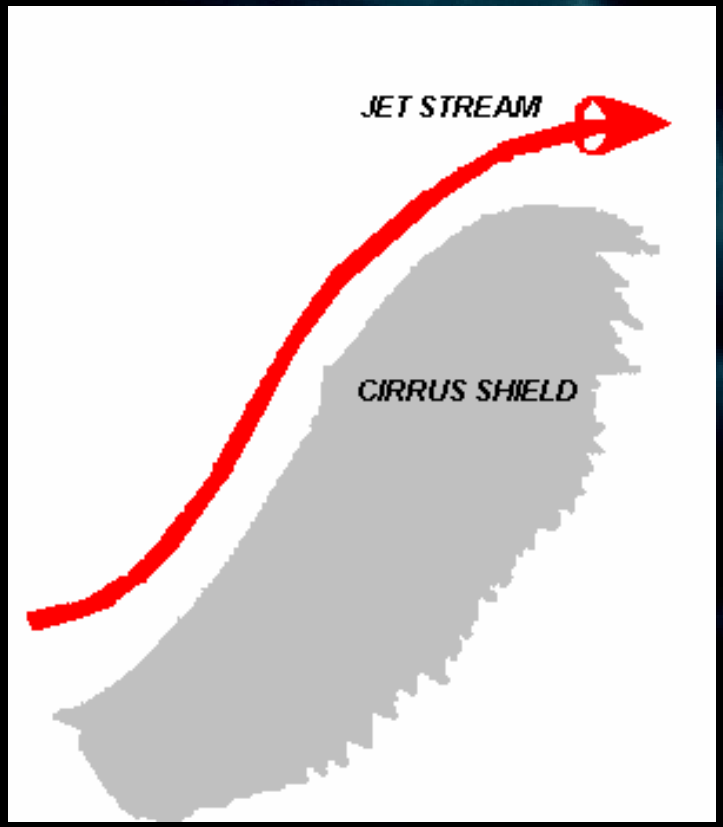
- Jet streams
  - General rules for jet stream axis location
    - 1° poleward of baroclinic zone cirrus
    - Upper level clouds are normally advanced downstream the farthest
    - No high clouds are present: 1-3° on the +n side of open-cell cu/closed cell SC boundary

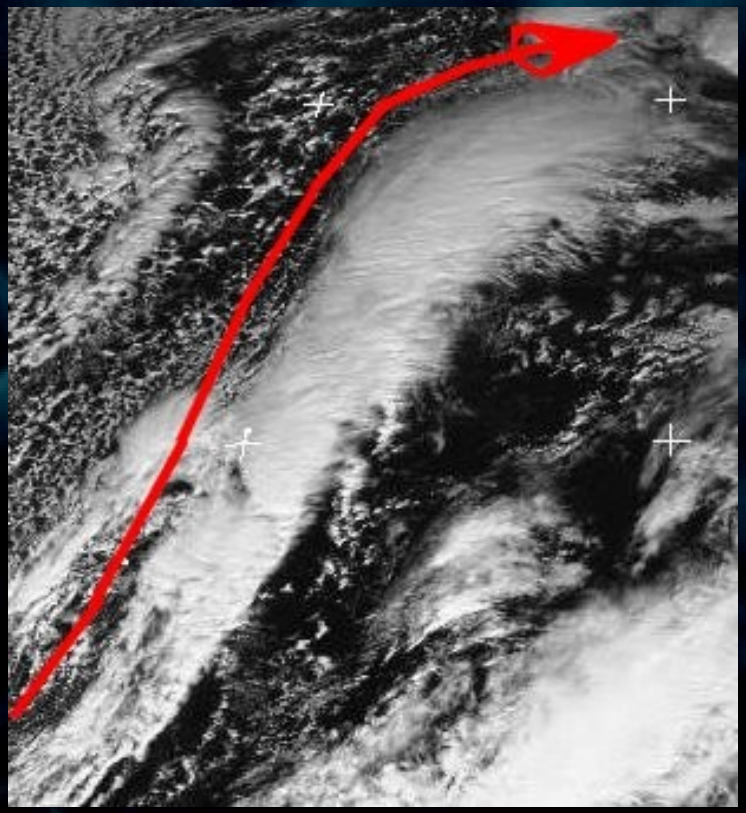
Analysis of Upper-level Features

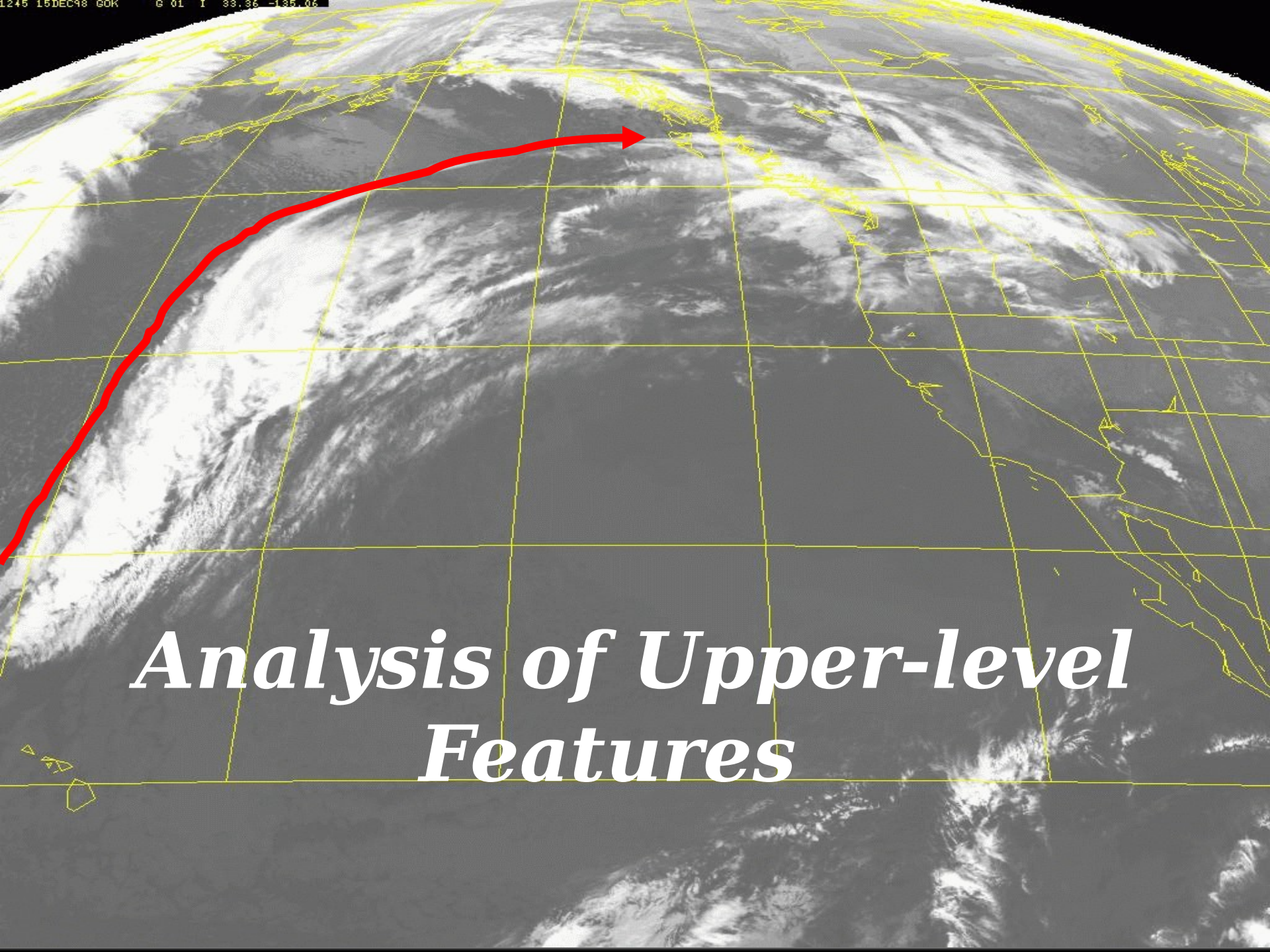
- Rule 1
  - Cirrus cloud shields tend to form on the anticyclonic shear side of the jet stream axis
  - A well defined cloud band is present along baroclinic zone cirrus



Locating the Jet Stream





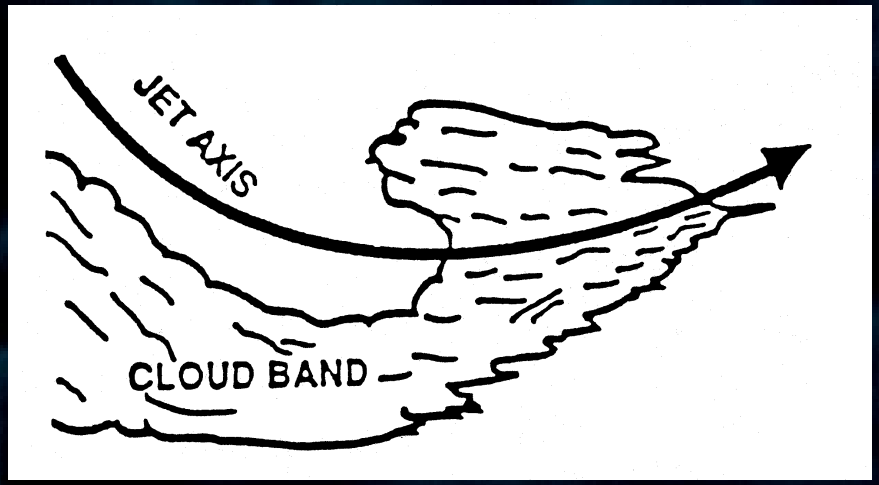


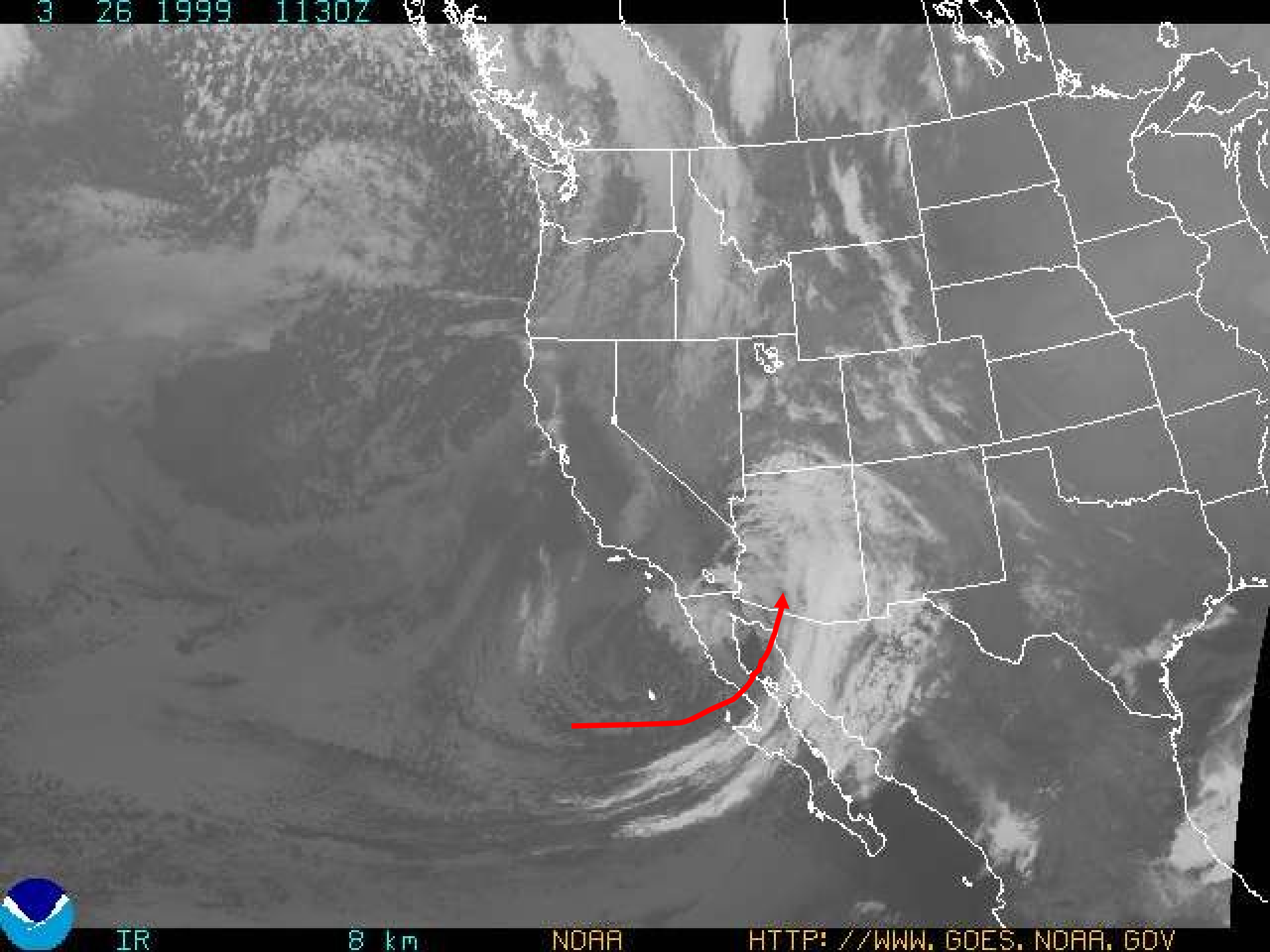
Analysis of Upper-level Features

Analysis of Upper-level Features

– Rule 2

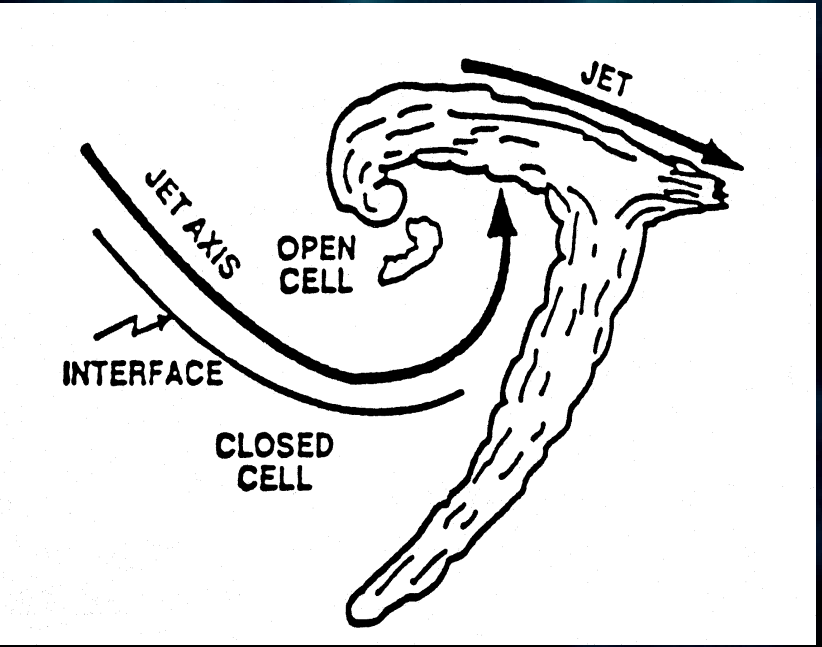
- Where baroclinic zone cirrus is not present, but other high or middle clouds are, cloud bands will be most advanced downstream
- The upstream borders, are usually well defined and form a U or V shape with axis of maximum winds over the slot



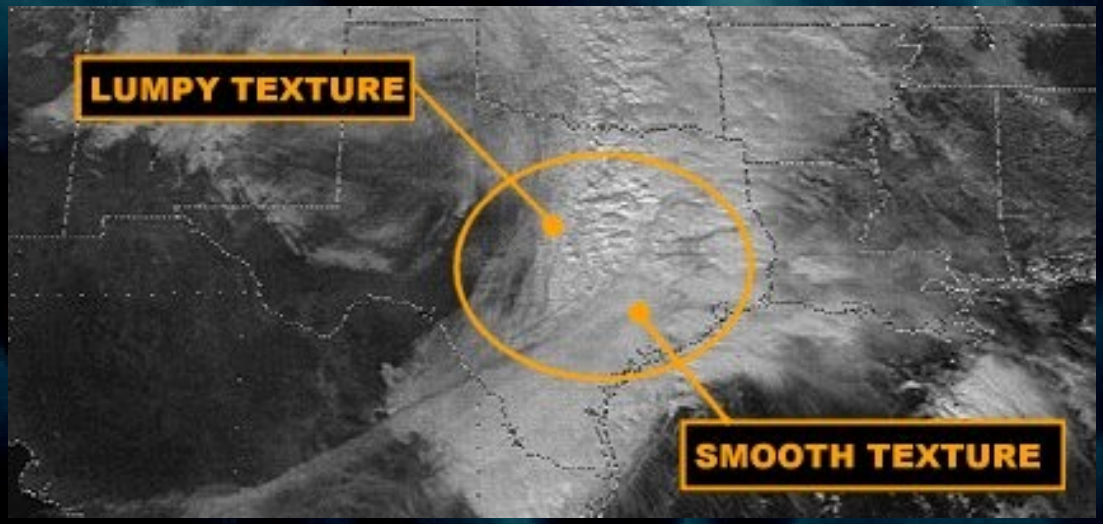

3 26 1999 1130Z
IR 8 km NOAA HTTP://WWW.GOES.NOAA.GOV

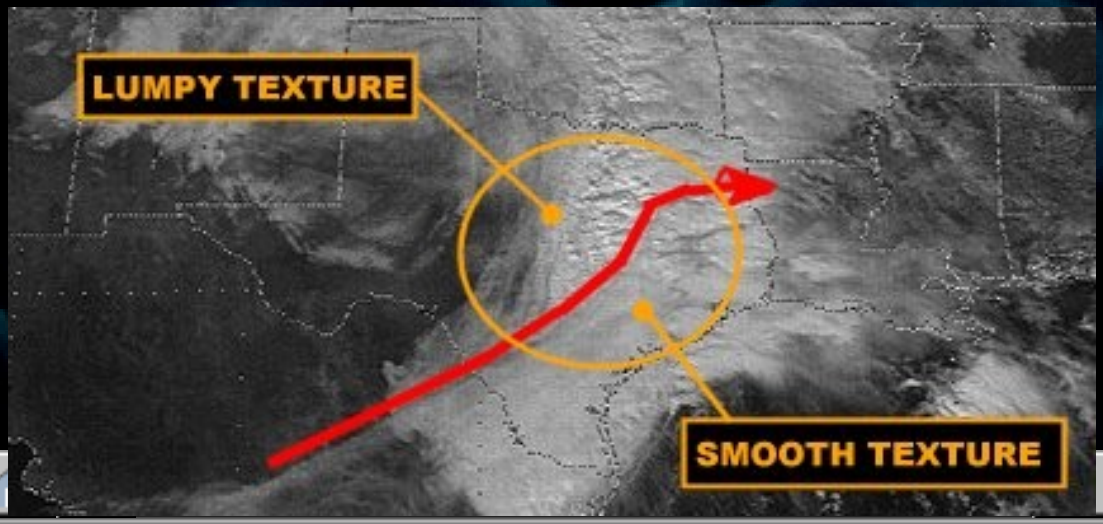
Analysis of Upper-level Features

- Rule 3
  - When no high clouds are present (with tops at jet stream levels), the axis of the jet stream will often be revealed as a boundary or interface between different types of low-level cloud cover

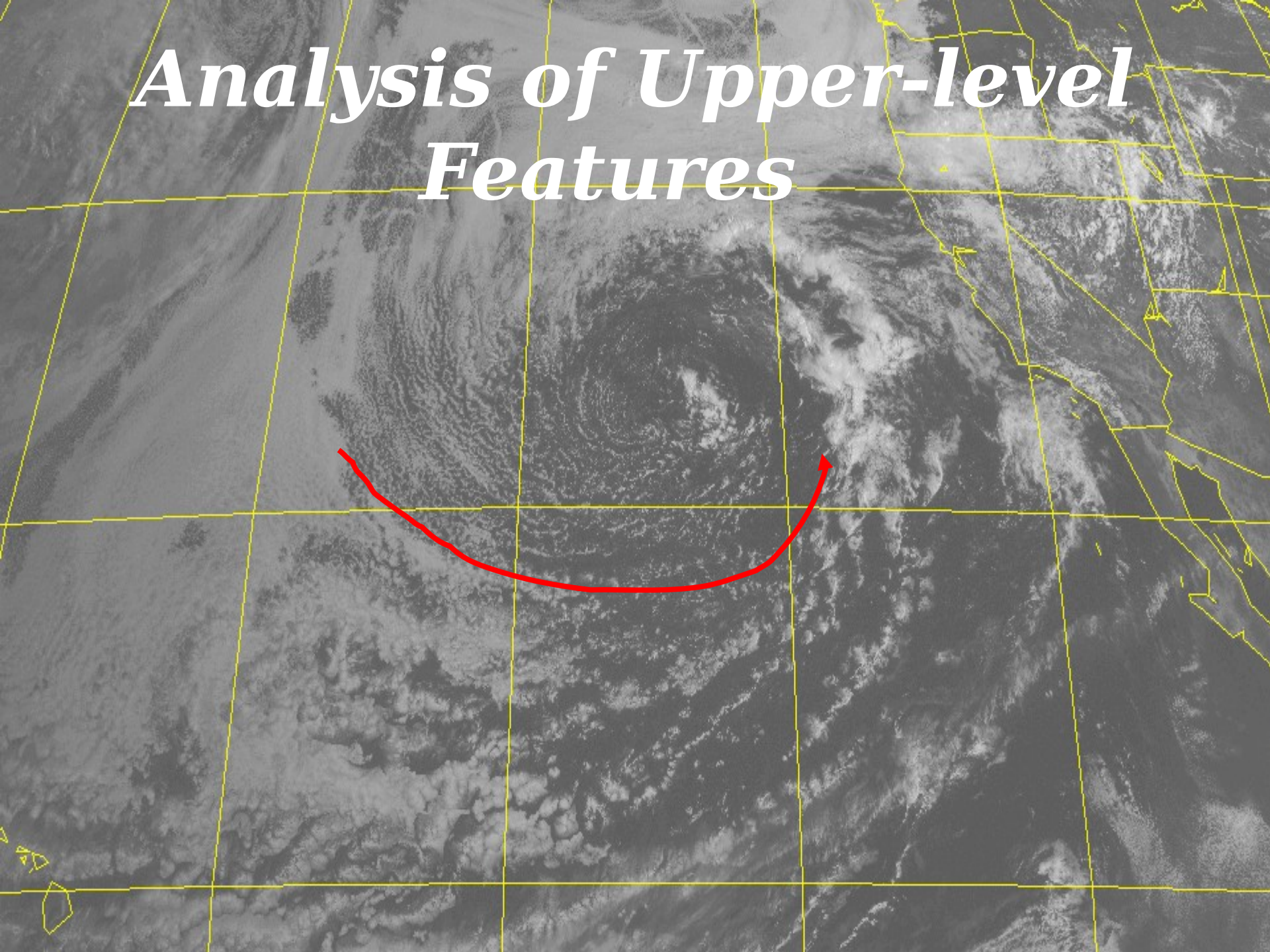


Using Low Cloud





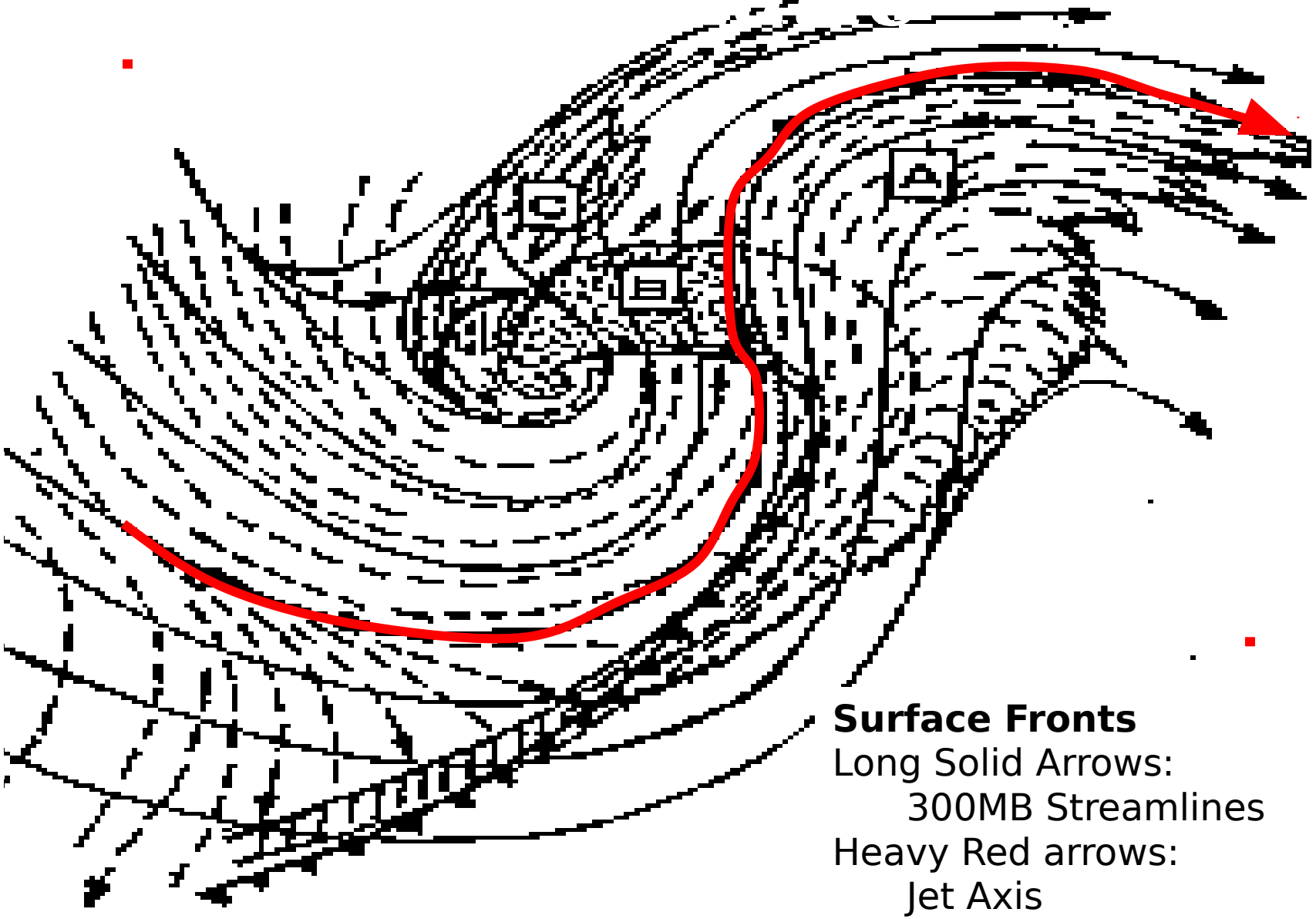
Analysis of Upper-level Features



Analysis of Upper-level Features

- PFJ configurations. The polar front jet axis flows through synoptic scale comma cloud systems in one of two configurations
  - Type A system
  - Type B system

Type A Jet Stream Schematic

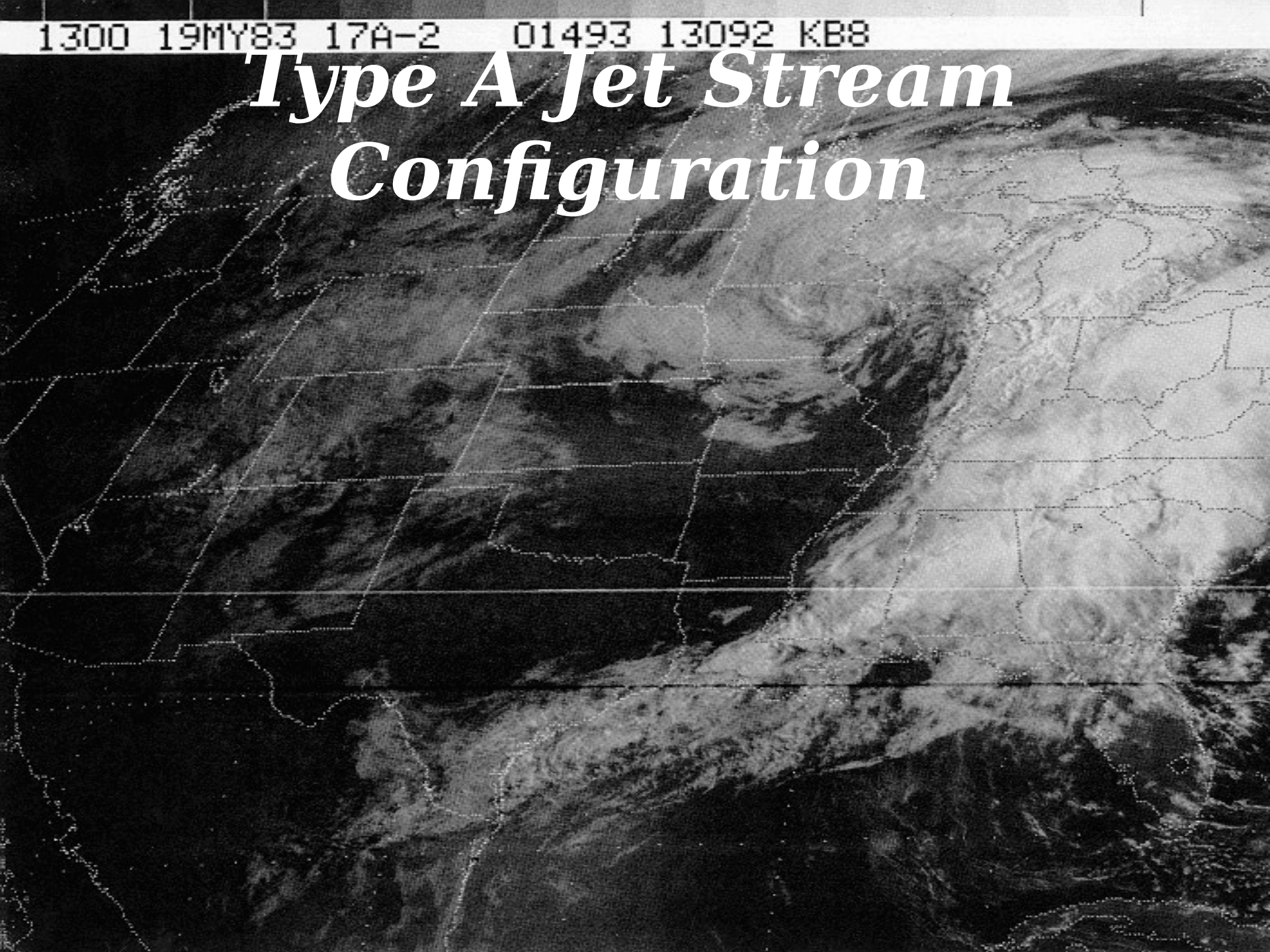


Surface Fronts

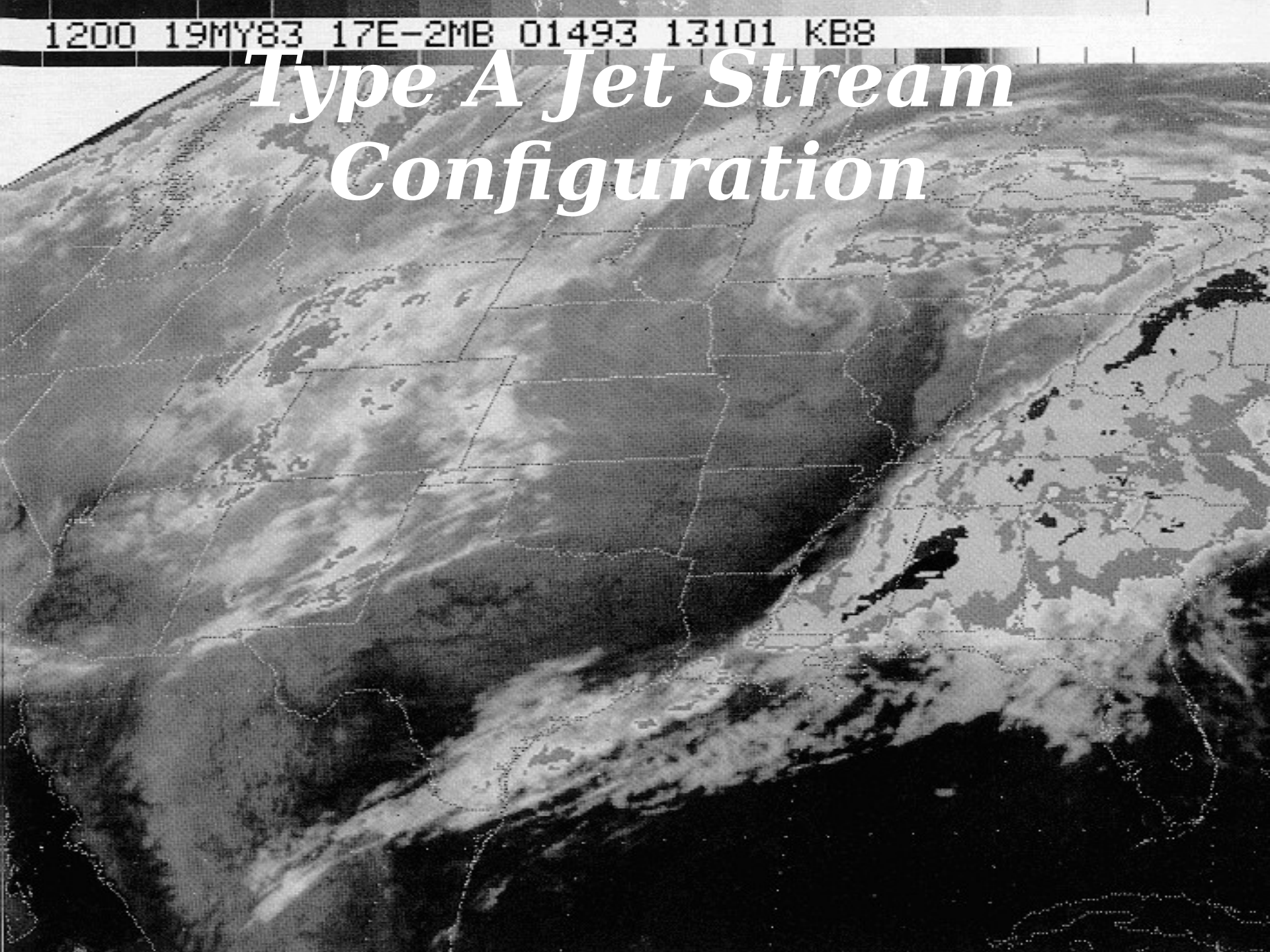
Long Solid Arrows:
300MB Streamlines

Heavy Red arrows:
Jet Axis

Short Dashed Lines:
Low-level Streamlines

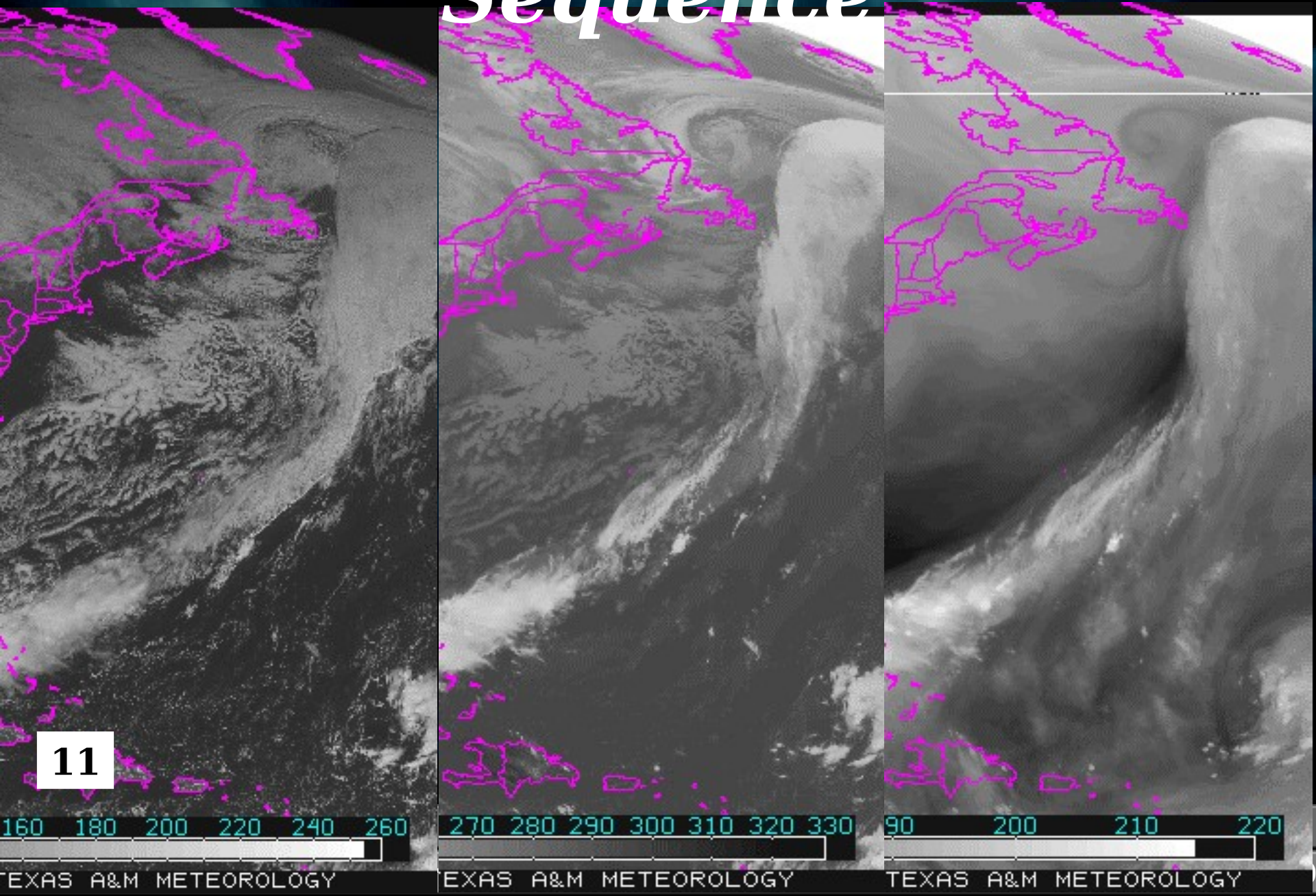


Type A Jet Stream Configuration

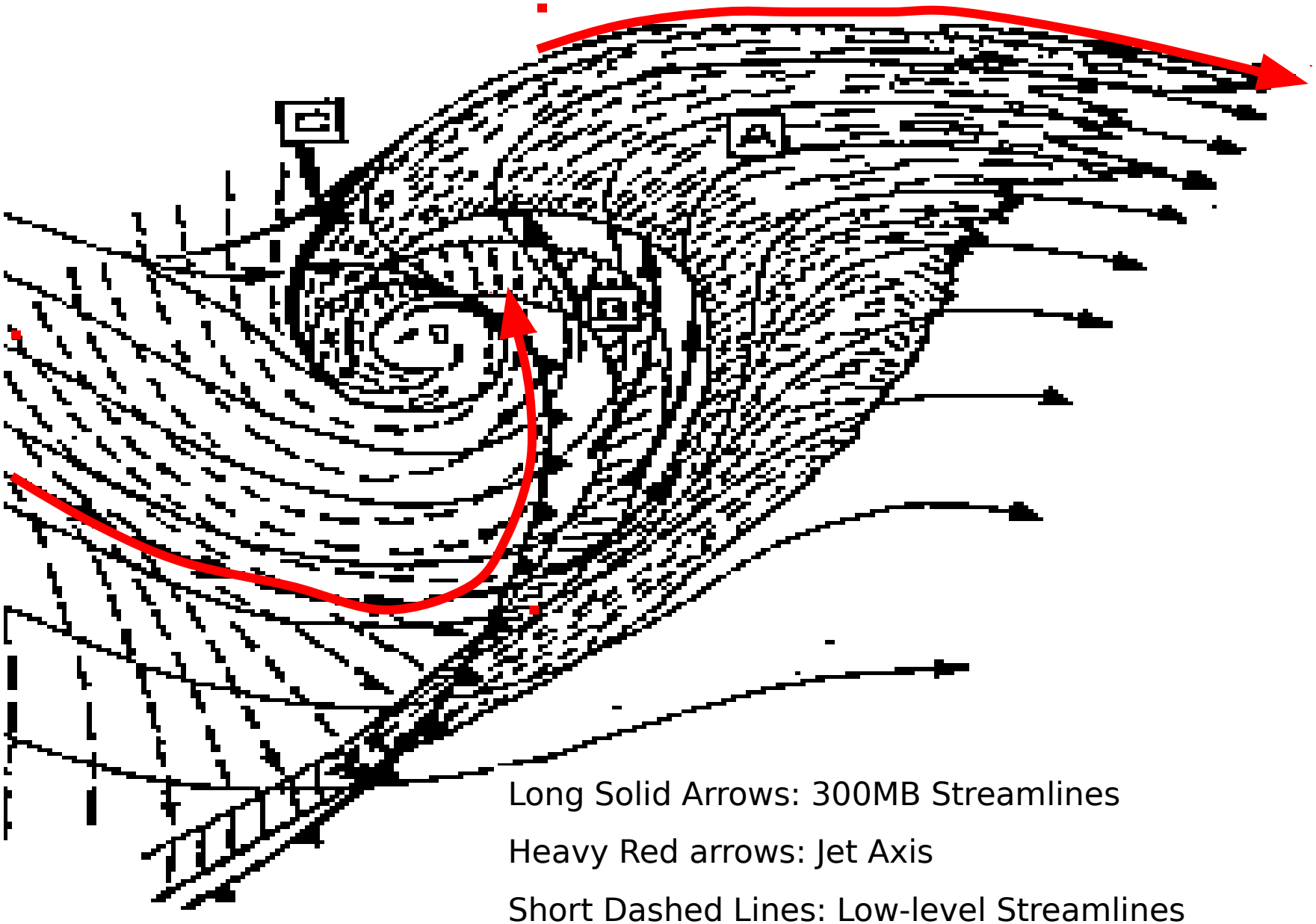


Type A Jet Stream Configuration

Type A Jet Stream Sequence



Type B Jet Stream Schematic

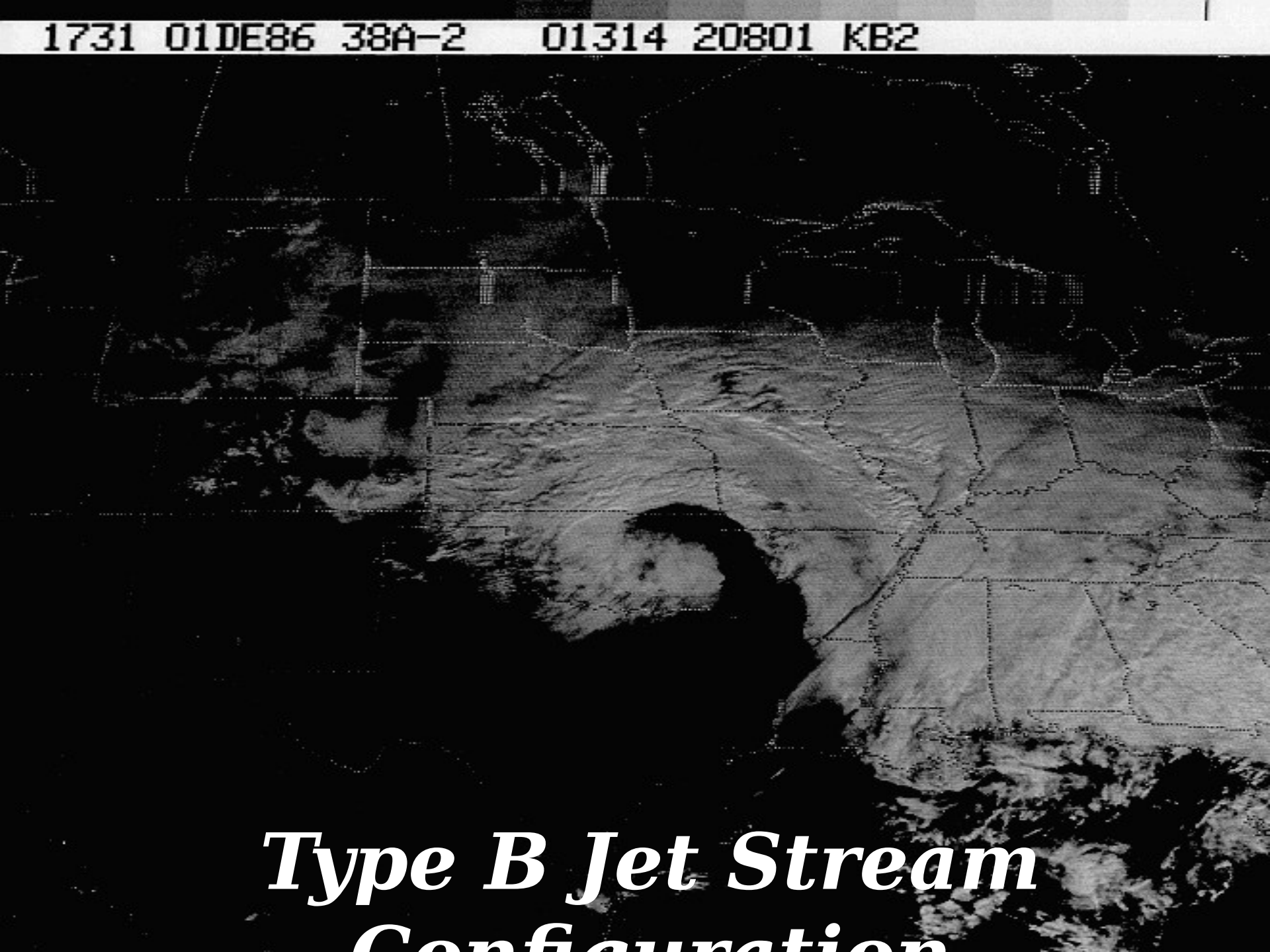


Long Solid Arrows: 300MB Streamlines

Heavy Red arrows: Jet Axis

Short Dashed Lines: Low-level Streamlines

Type B Jet Stream Configuration



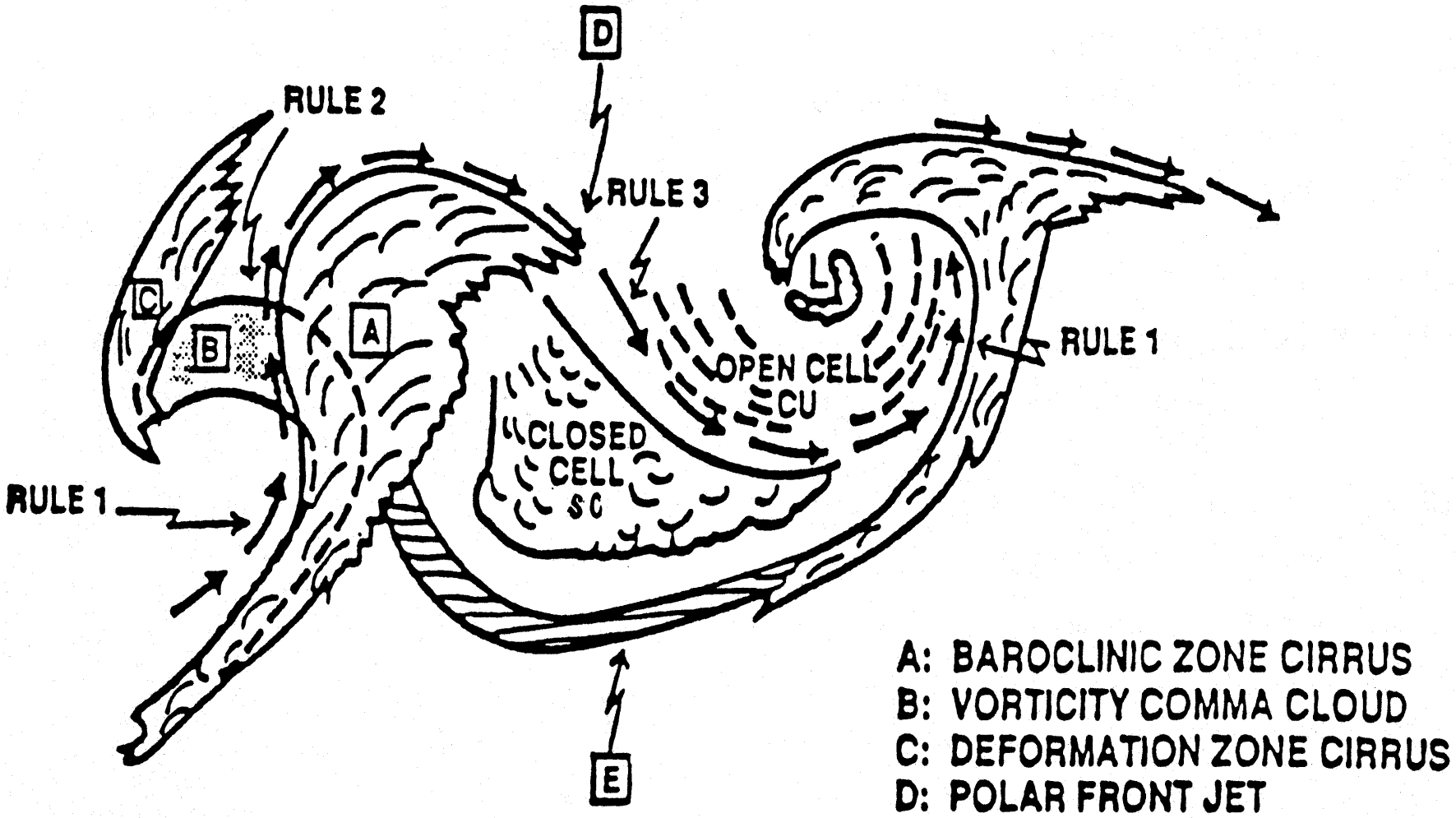
Type B Jet Stream Configuration

Type B Jet Stream Configuration

Type B Jet Stream Configuration

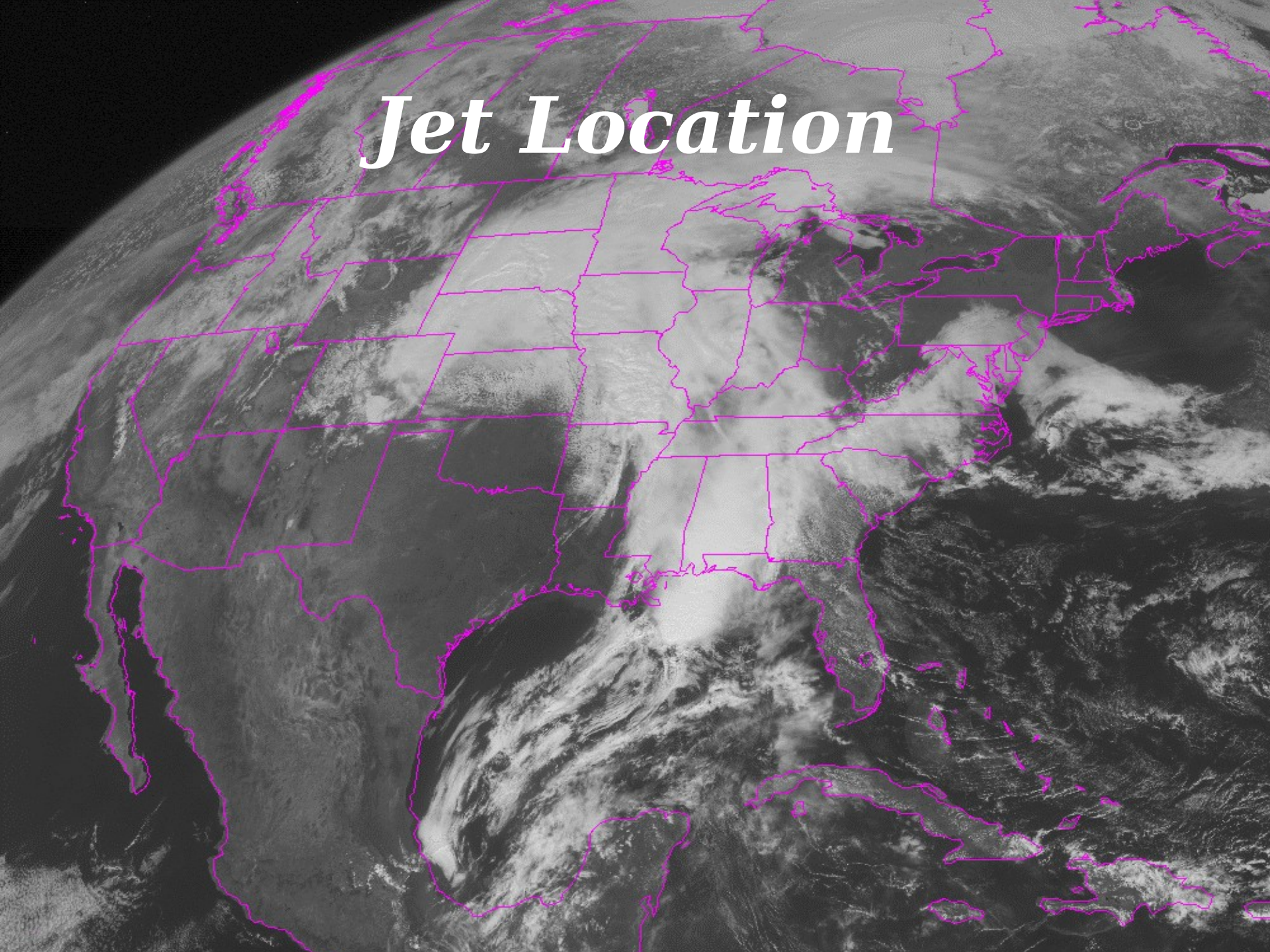
Type B Jet Stream Configuration

Combination of Systems



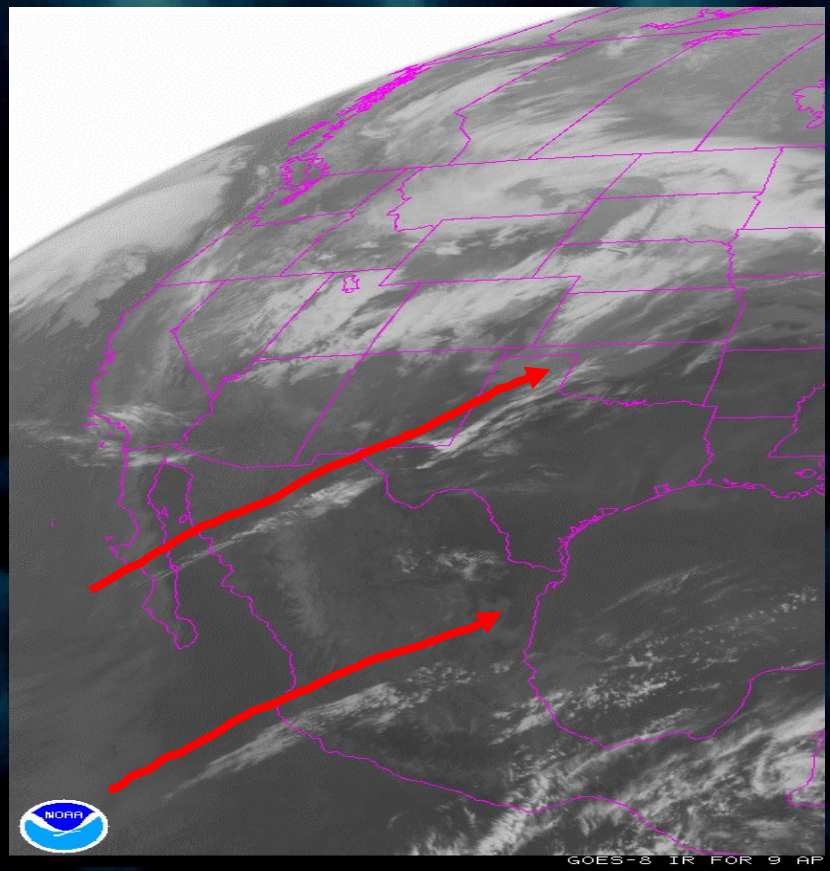
Analysis of Upper-level Features

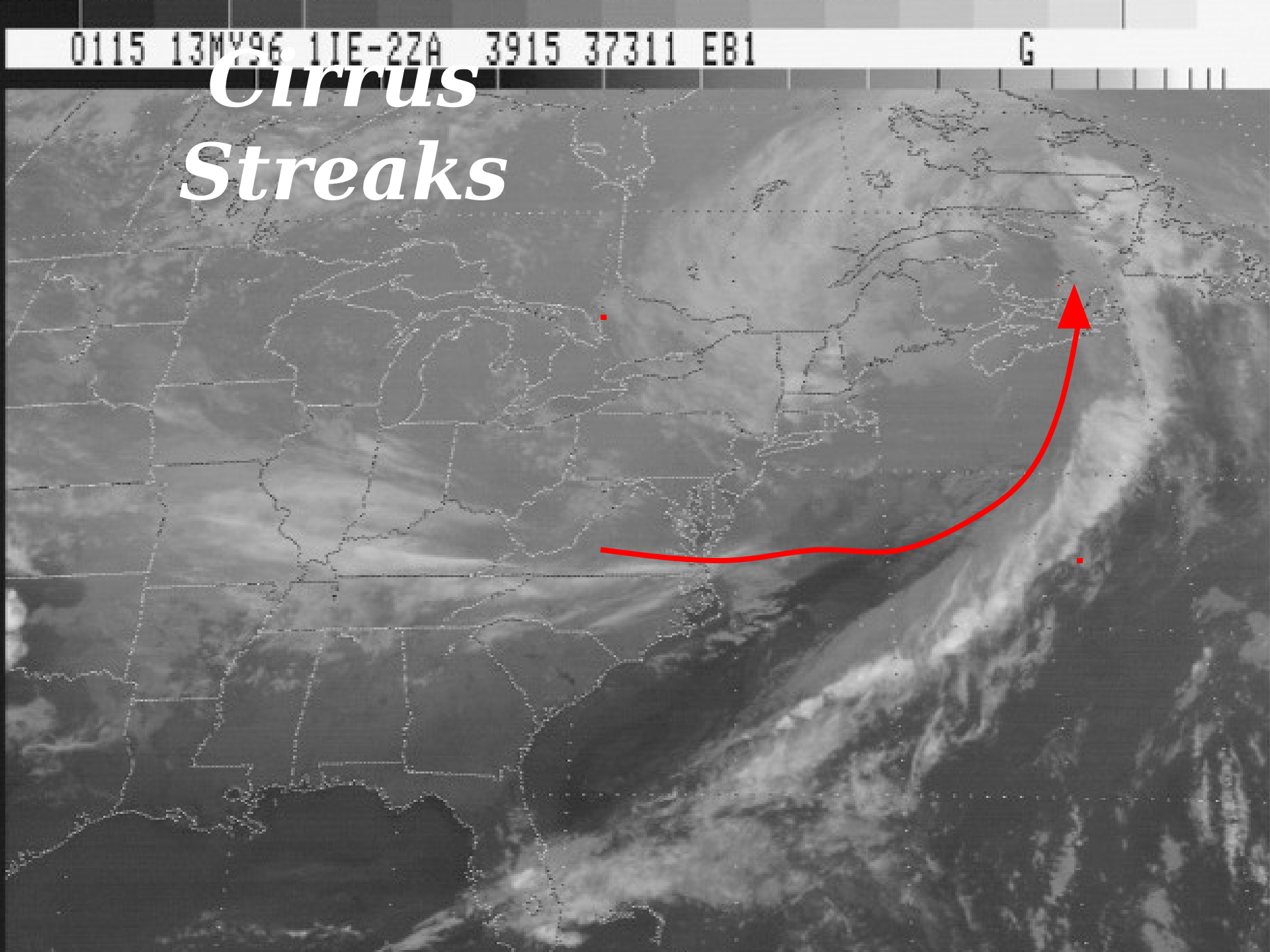
- Using cloud phenomena to identify the je t stream
  - 1° of latitude poleward of cirrus streaks.
  - Transverse bands
    - Perpendicular to jet axis
    - -N side of jet (subtropical jet stream)
  - 1° of latitude poleward of lee-of-the-mountain cirrus (+n)
  - Cloud shadows


Jet Location

Jet Location

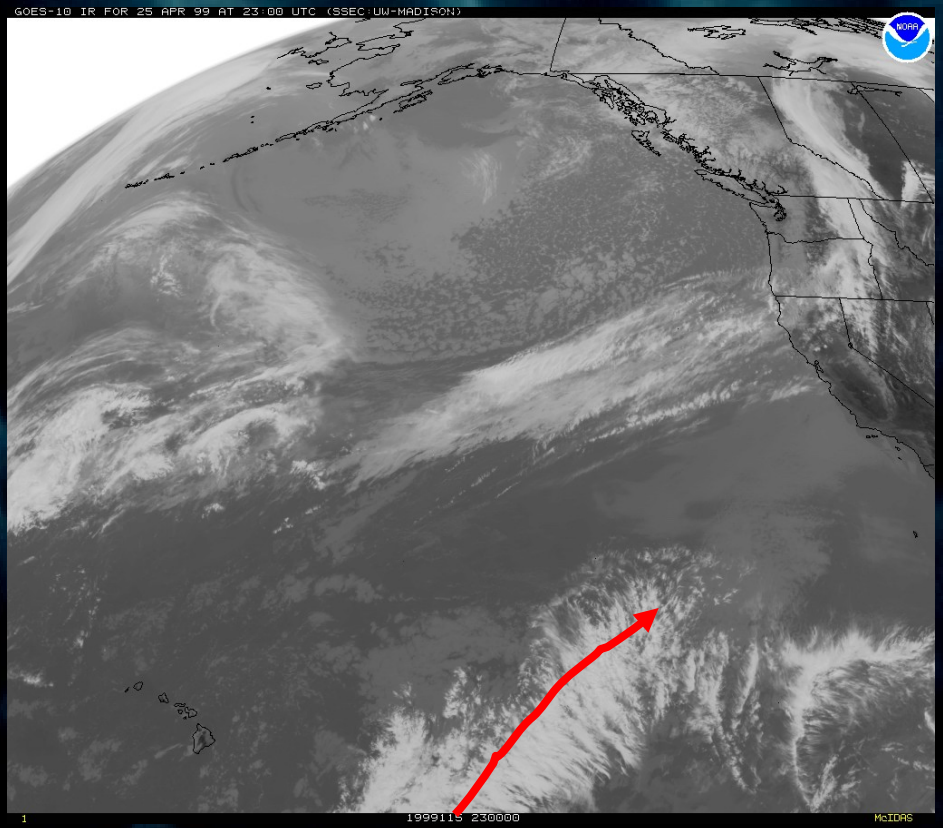
- Cirrus streaks
  - Form parallel and to right of jet stream when there is insufficient moisture to form full cirrus shield

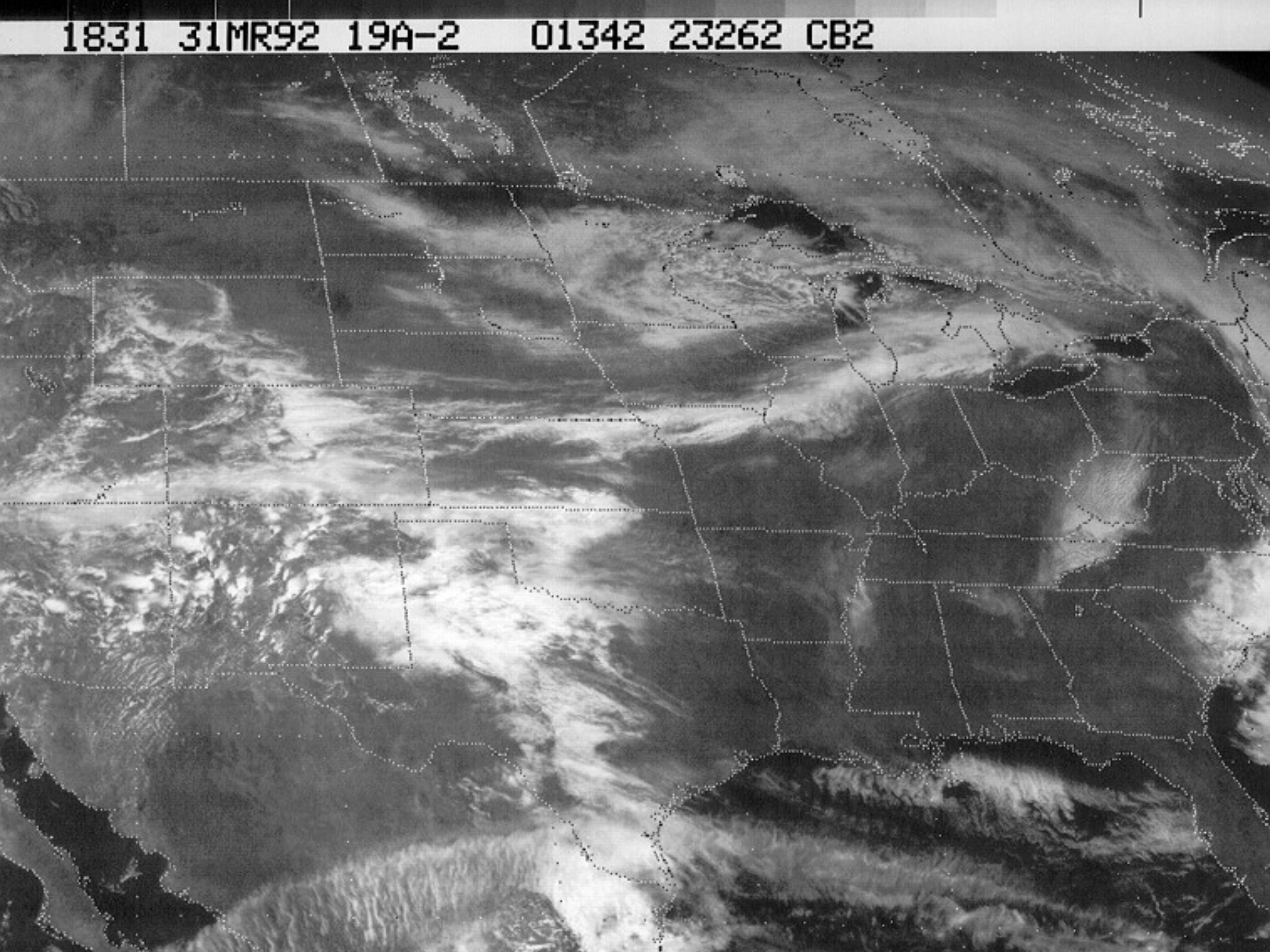



0115 13MY96 1IE-2ZA 3915 37311 EB1 G
Cirrus
Streaks

Jet Location

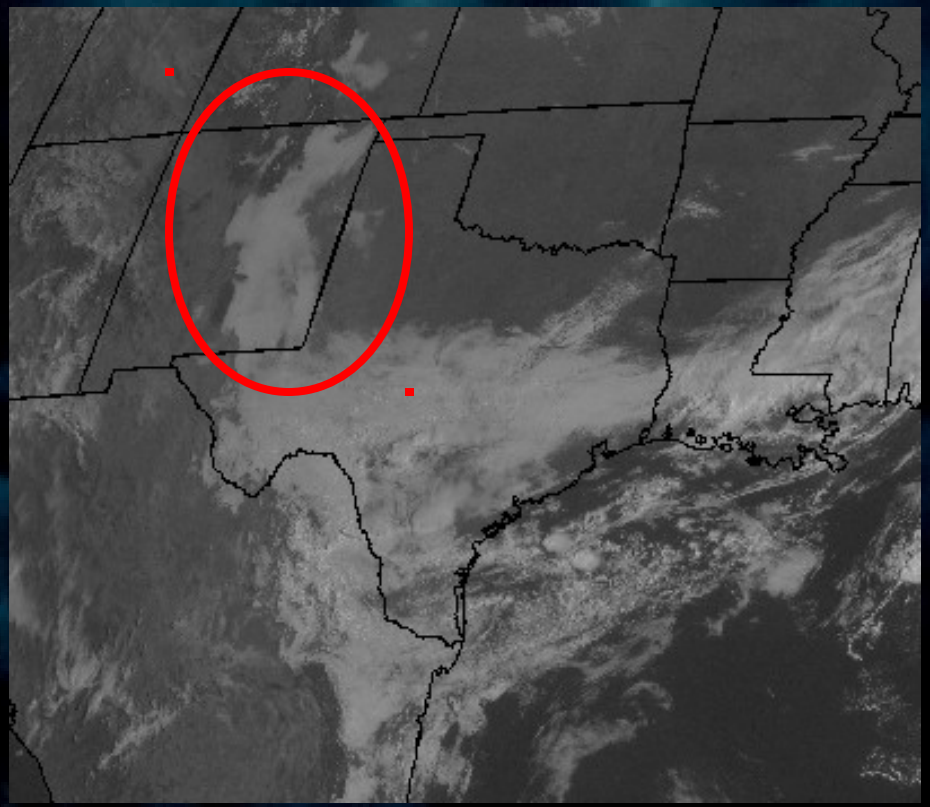
- Transverse bands
  - An excellent indicator of jet speed maximum within the jet axis

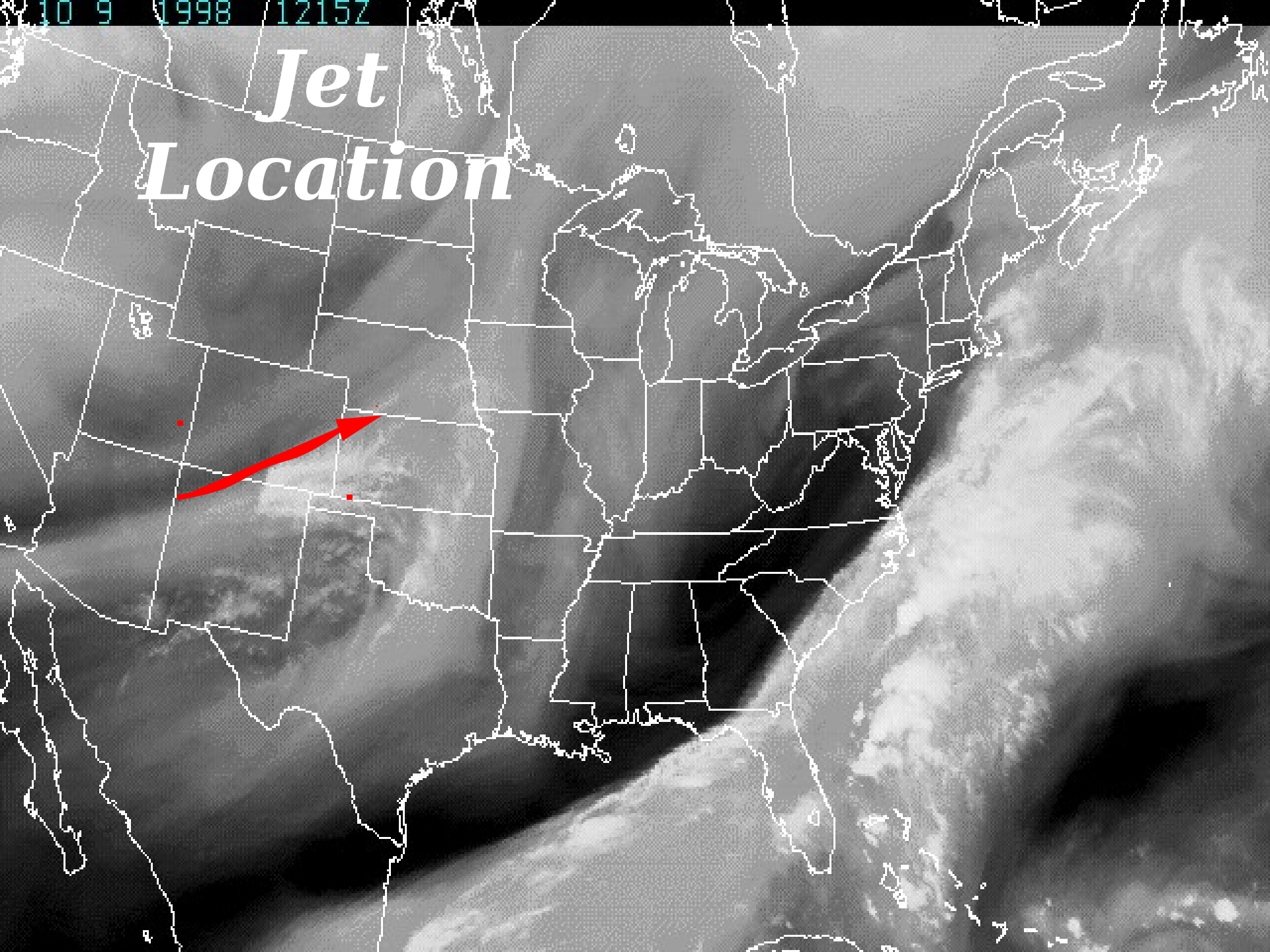



1831 31MR92 19A-2 01342 23262 CB2

Jet Location

- Lee of mountain cirrus
  - Low-level stratiform clouds often pile up on windward sides of mountain chains

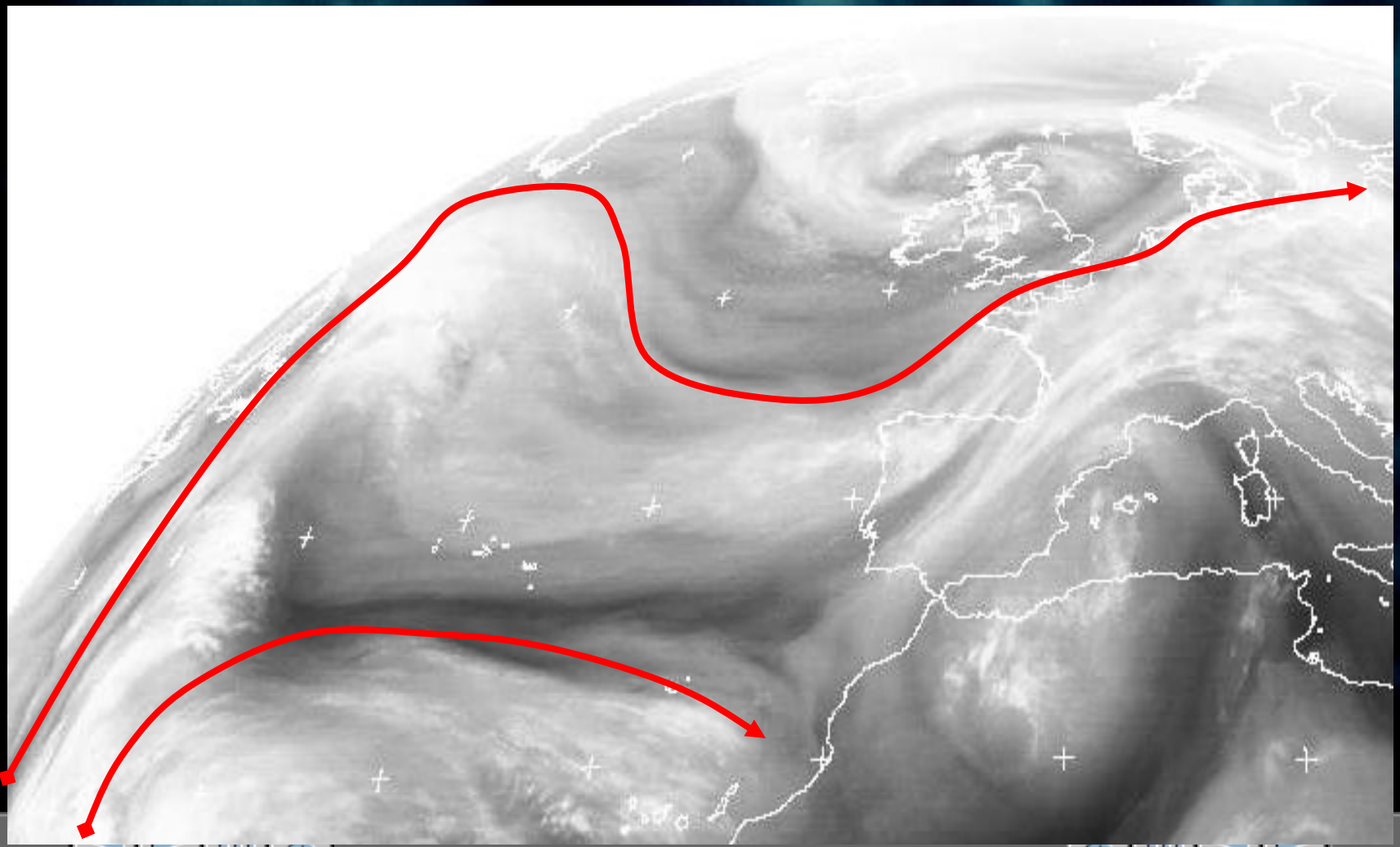



10 9 1998 1215Z
Jet
Location

Analysis of Upper-level Features

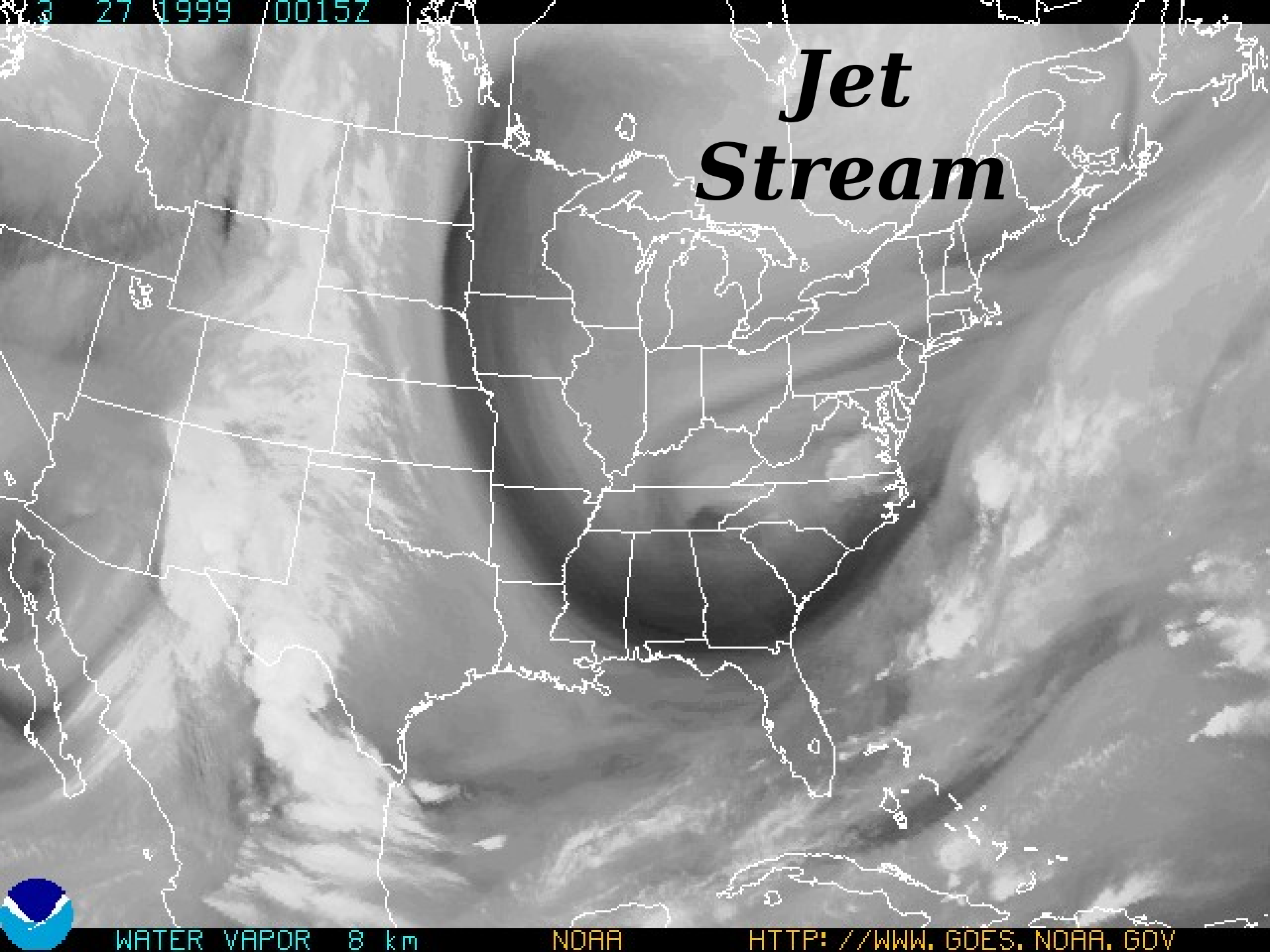
- Water vapor imagery
  - Water vapor imagery is helpful in placing the jet stream accurately in clear regions.
  - The jet stream is associated with the boundary between dark (dry) and light (moist) regions.
  - In straight-line flow the jet axis is located in the center of dark band.
  - In cyclonically curved flow it's on the +n side of dark band and the jet axis wants to stay on the inside track in the curves.

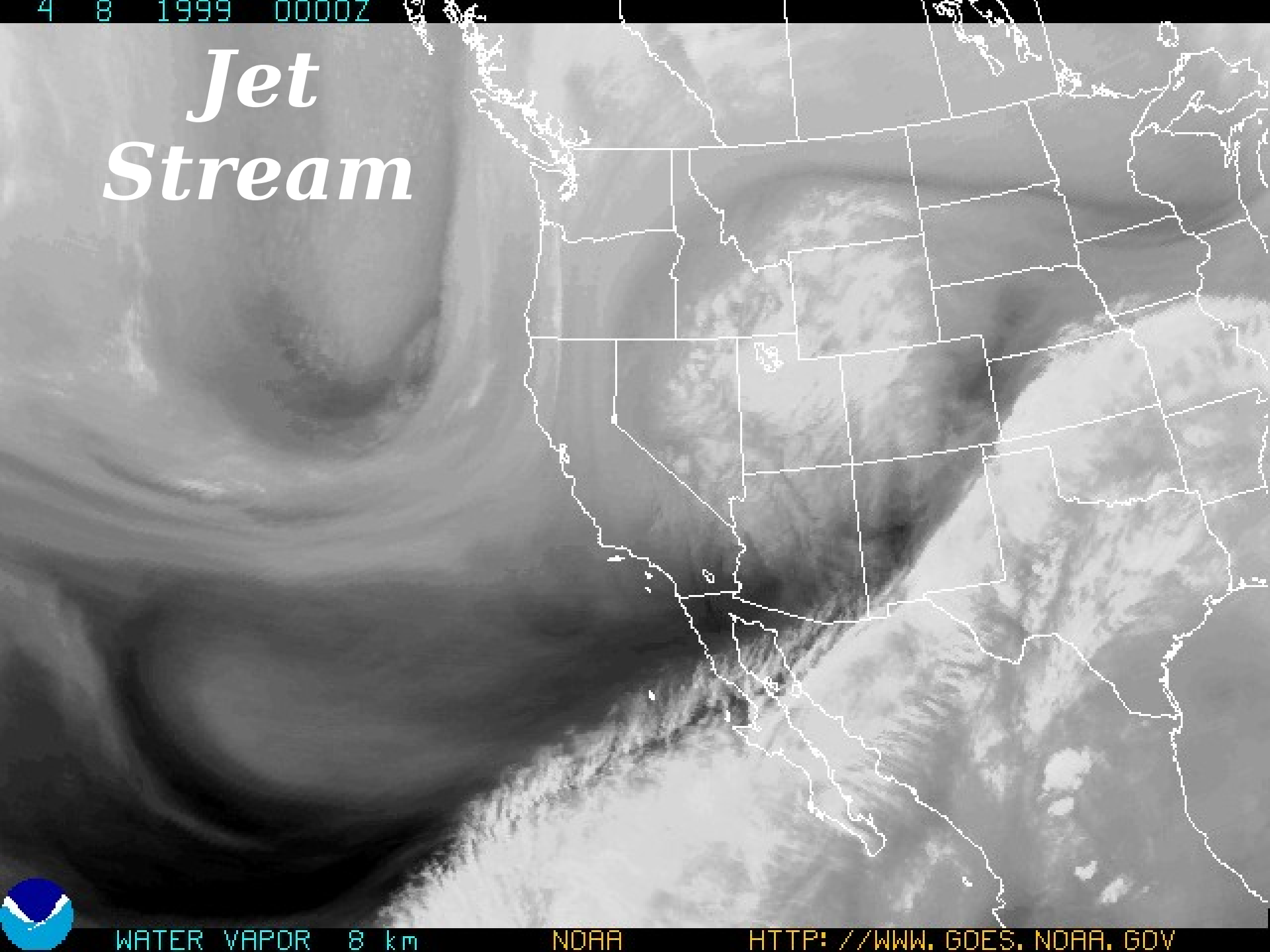
Using Water Vapor



Analysis of Upper-level Features

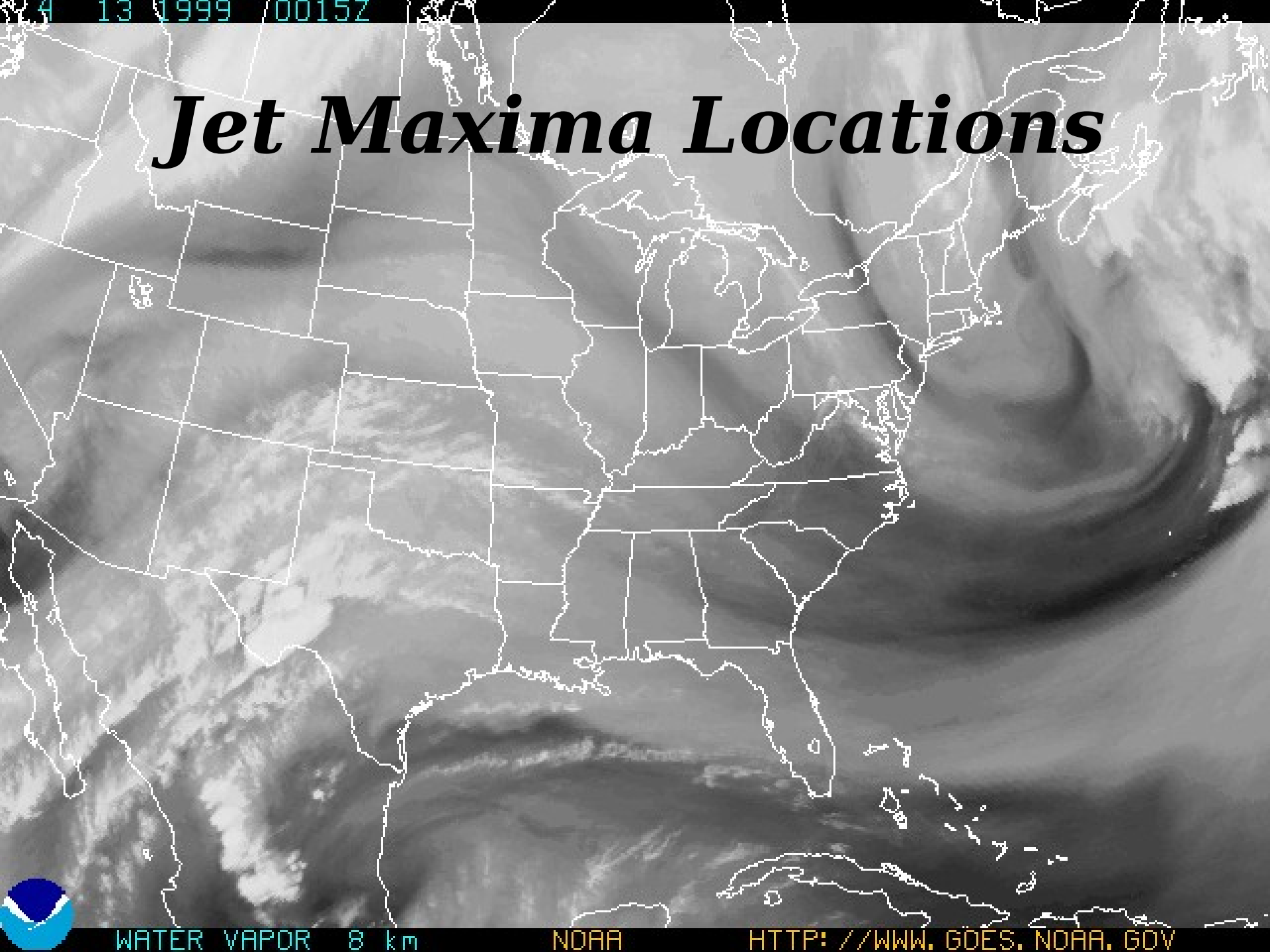
- And in anticyclonically curved flow it's on the -n side of dark band and the jet axis wants to stay on the inside track in the curves.
- Darkening/widening indicates a strengthening of the associated jet stream.
- Not all areas of gray shade contrast are jet streams.

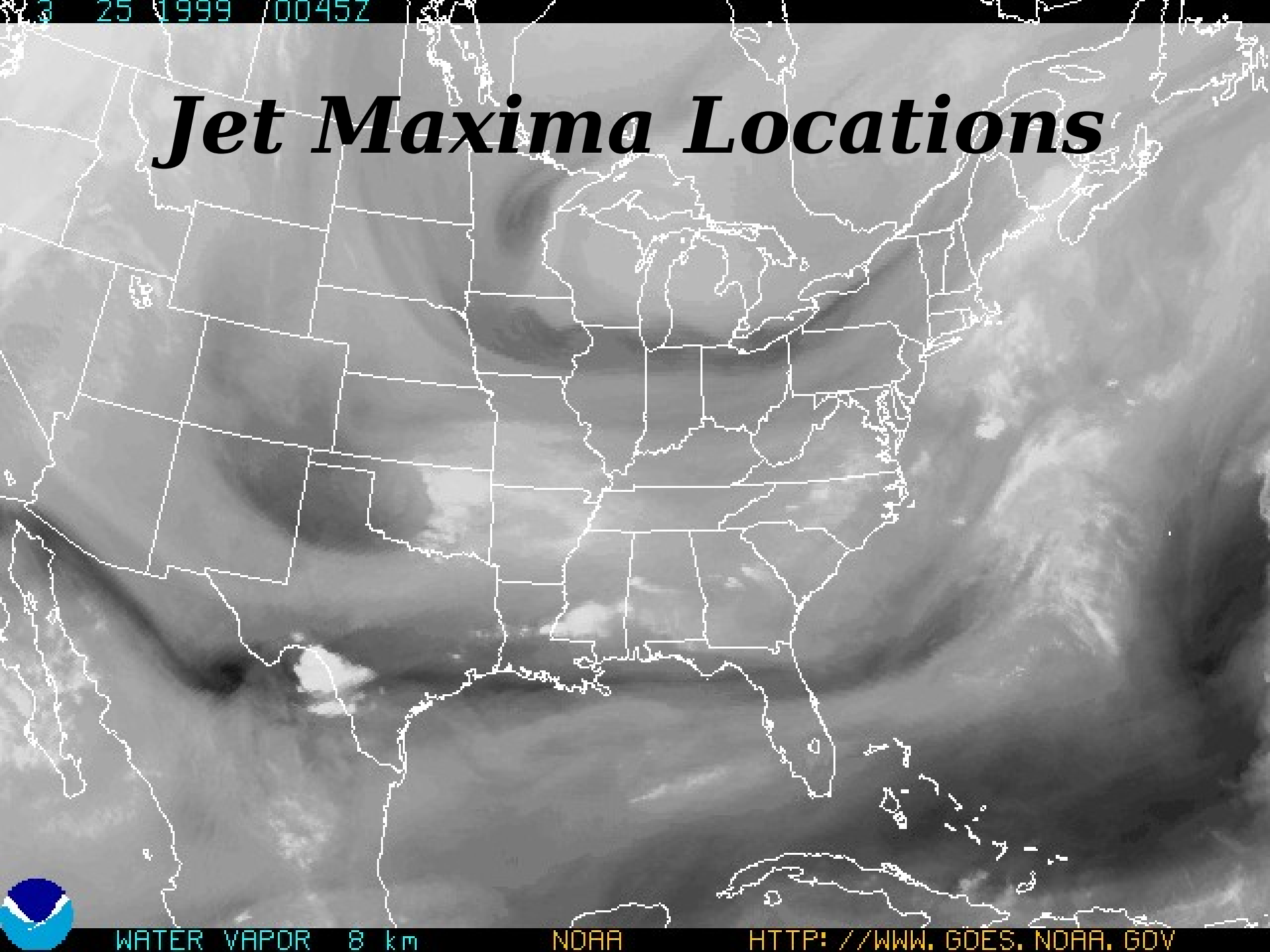

3 27 1999 0015Z
Jet Stream
WATER VAPOR 8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

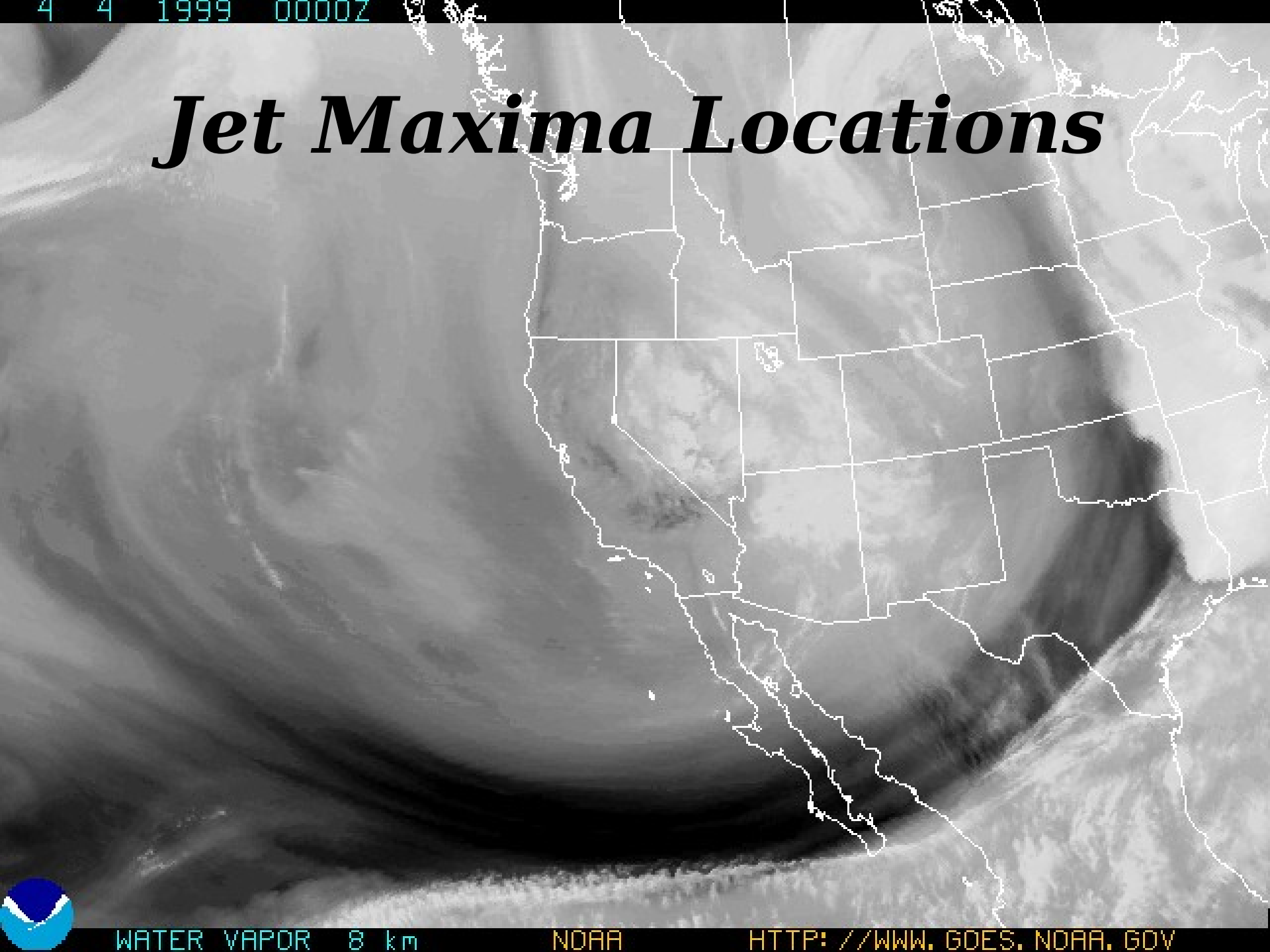

4 8 1999 0000Z
Jet Stream
WATER VAPOR 8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

Analysis of Upper-level Features

- Jet stream speed maxima placement
  - Speed maxima in the **dry slot**.
    - IR imagery and VIS imagery - usually cloud free on IR; Some low clouds on VIS.
    - WV imagery - appears as dark band.
  - Speed maximum typically downstream from the ridge axis.


13 1999 0015Z
Jet Maxima Locations
WATER VAPOR 8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

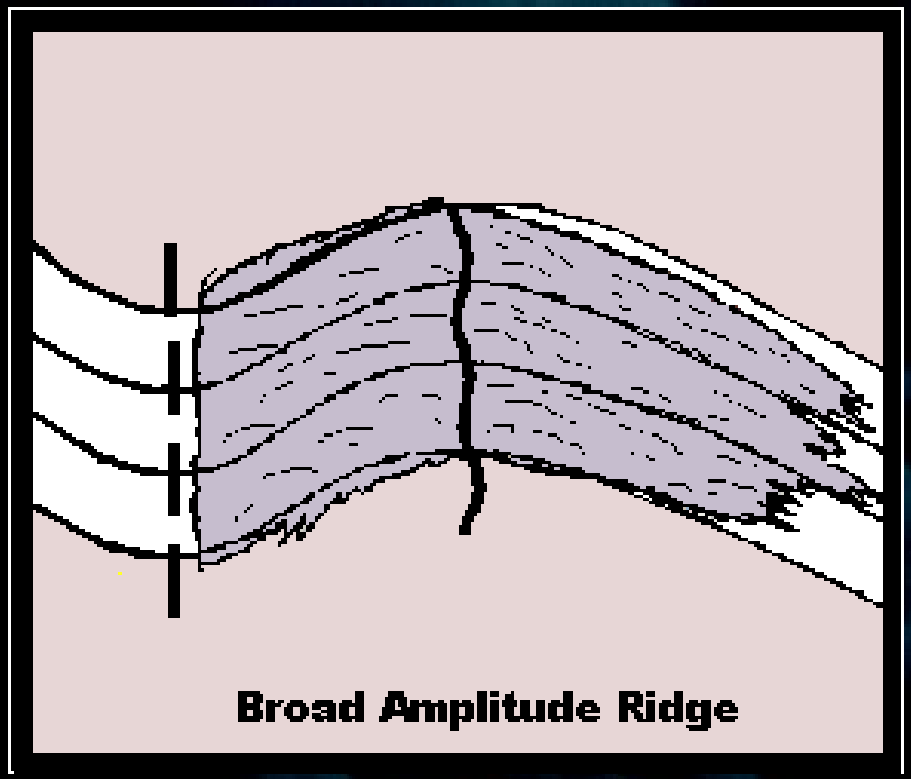

3 25 1999 /0045Z
Jet Maxima Locations
WATER VAPOR 8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

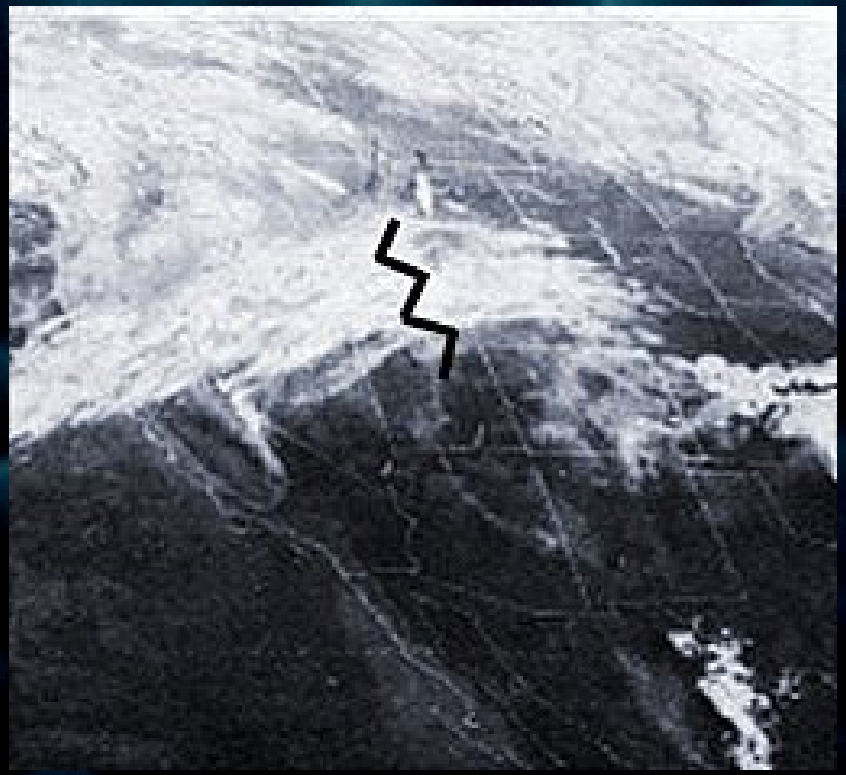

4 4 1999 0000Z
Jet Maxima Locations
WATER VAPOR 8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

Analysis of Upper-level Features

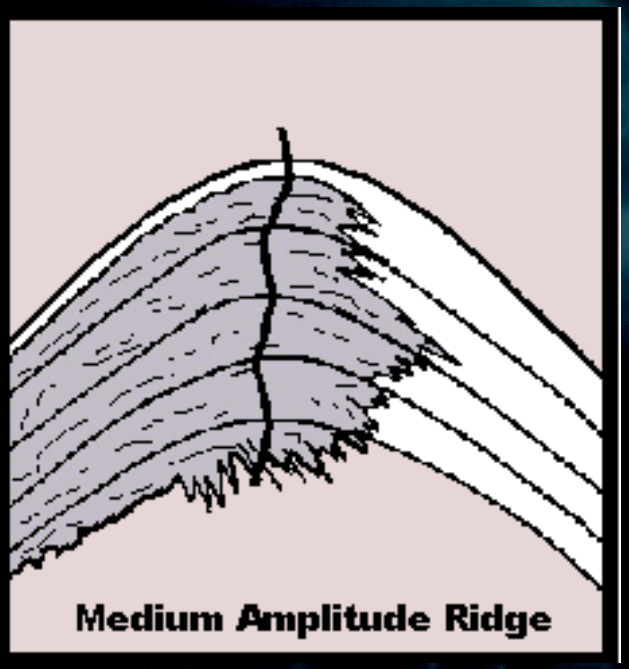
- Long waves
  - Ridges
    - IR and VIS imagery - use the rules previously discussed to locate the jet stream; The ridge lies in the area of broad anticyclonic turning.
    - WV imagery - excellent tool for long wave location. The ridge normally lies in an area of drying (darkening on the WV image).

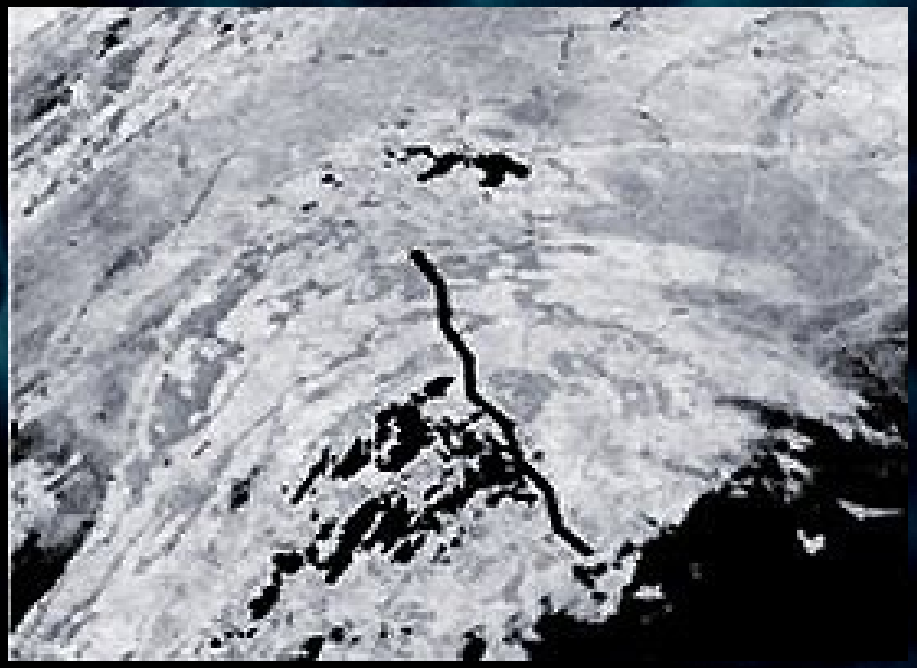
Broad Amplitude Ridge



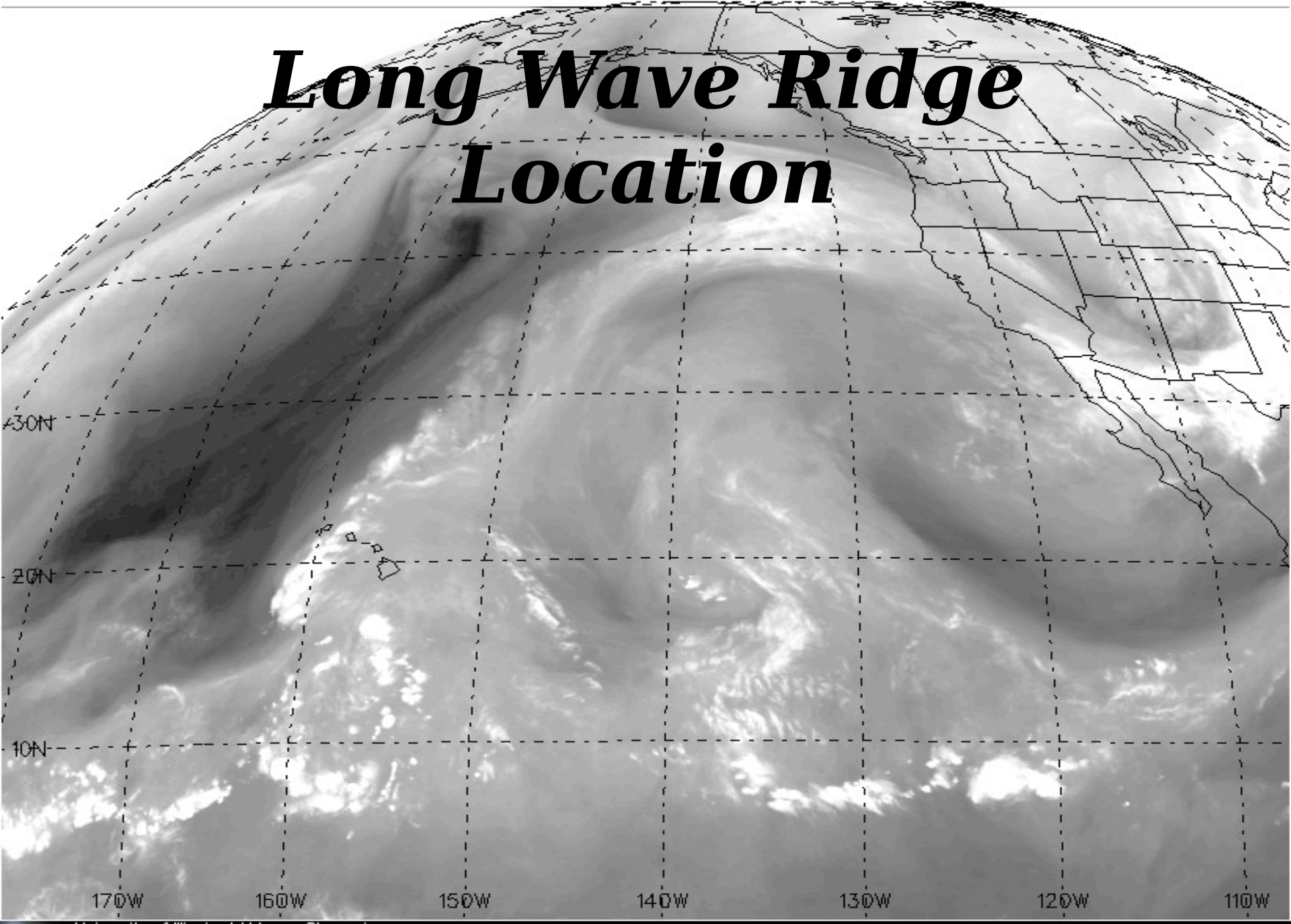


Medium Amplitude Ridge





Long Wave Ridge Location



University of Illinois at Urbana-Champaign
Department of Atmospheric Sciences
http://www.atmos.uiuc.edu/

GOES9 Pacific/Western Water Vapor Image
November 16, 1996 11GMT

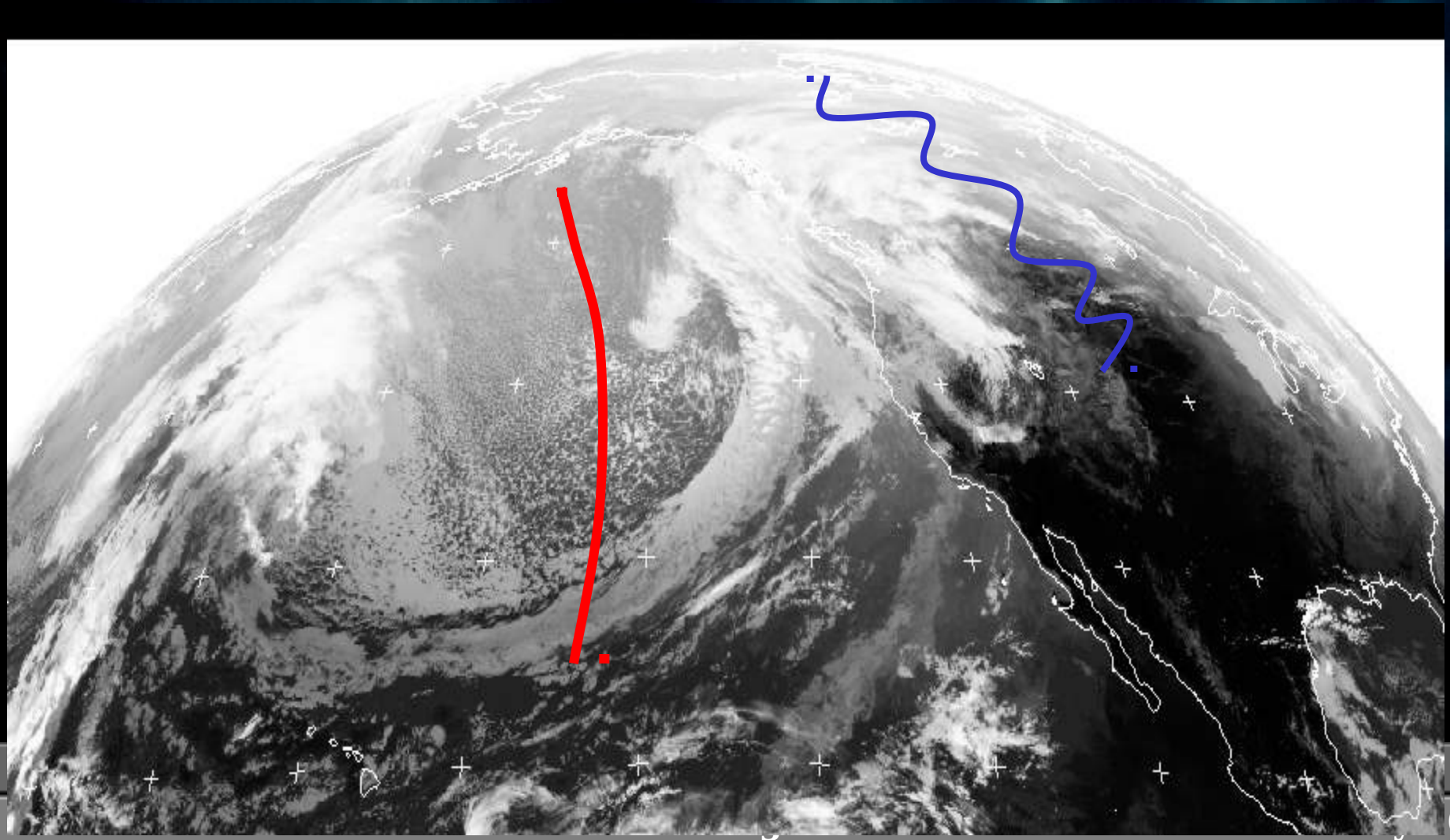
Analysis of Upper-level Features

- Troughs
  - IR and VIS imagery - again, use the rules already mentioned.
  - WV imagery - look for broad cyclonic turning and increase moisture.

University of Illinois at Urbana-Champaign
Department of Atmospheric Sciences
http://www.atmos.uiuc.edu/

GOES8/9 Comp. N.A. Water Vapor Image
January 28, 1997 00GMT

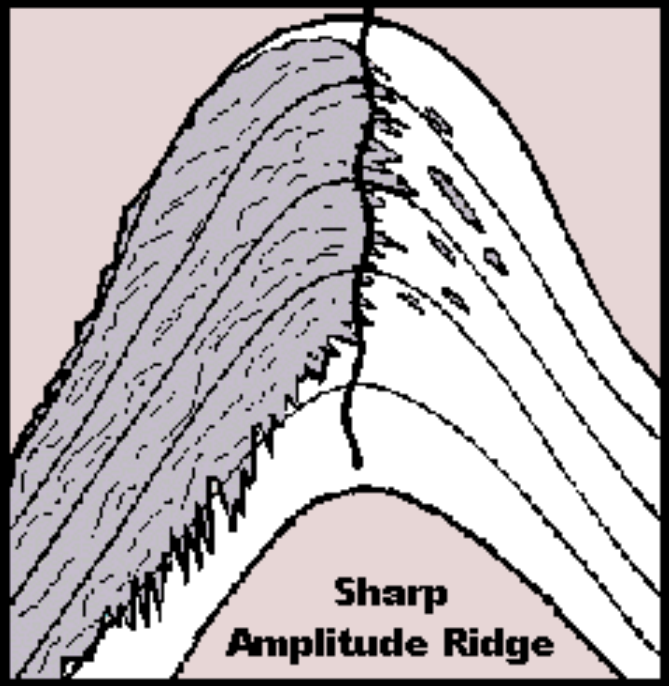
Long-wave Troughs

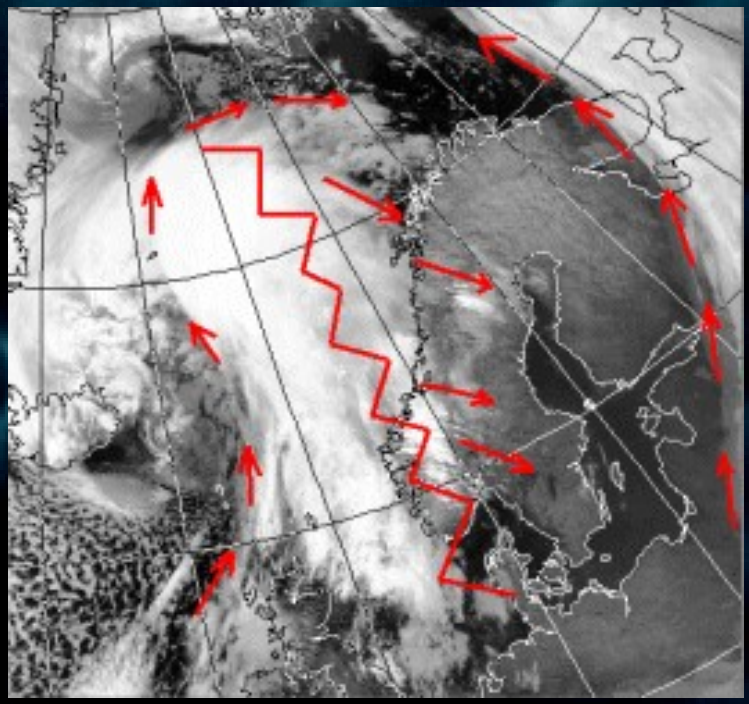


Analysis of Upper-level Features

- Major and minor short waves
  - Ridges - maximum anticyclonic curvature of the high clouds.
    - IR and VIS imagery - the clouds are most prevalent on the upstream side of the ridge axis.
      - Low amplitude ridge. More clouds that will spill over the ridge axis and the wider the cloud band.
      - High amplitude ridge. More sharp the clearing at the ridge axis, and hence, the narrower the cloud band.
    - WV imagery - a moisture discontinuity exists across the ridge axis.

Sharp Amplitude Ridge



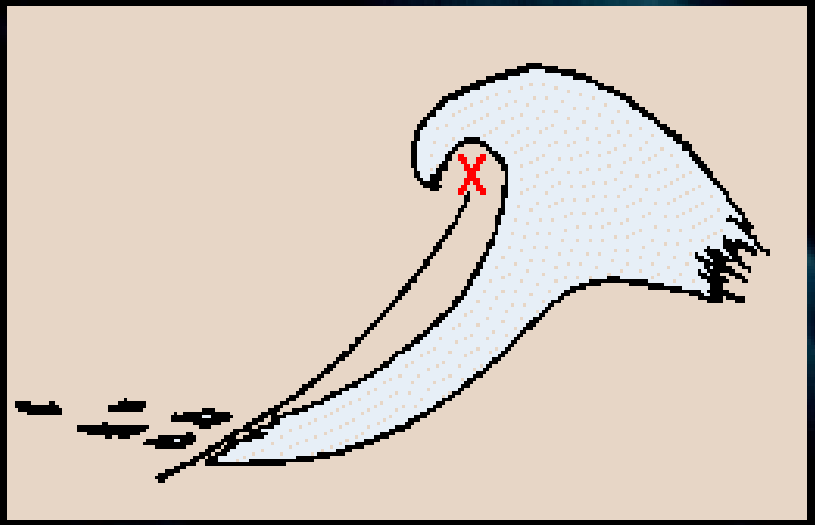


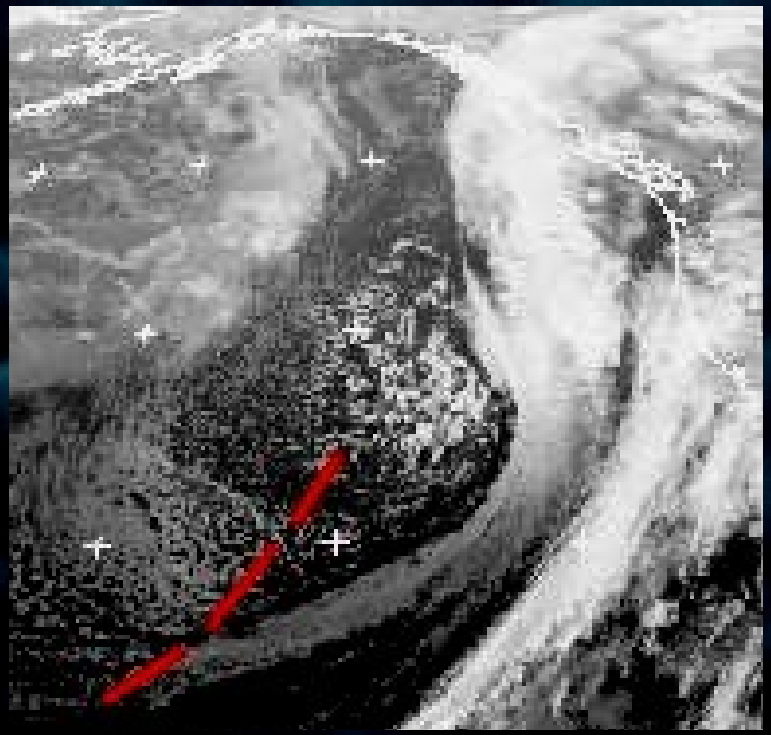
Short Wave Ridge
Location

Analysis of Upper-level Features

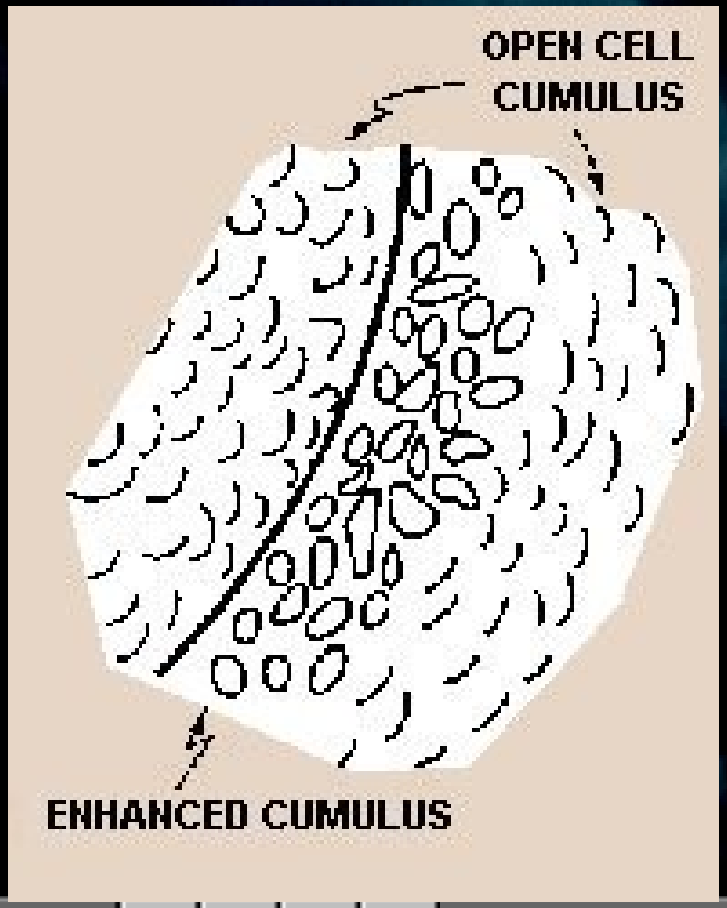
- Troughs. Maximum cyclonic curvature of high clouds.
  - Clouds are more prevalent downstream from the trough axis due to the associated divergence aloft.
    - IR and VIS imagery - vertically developed clouds more common downstream from axis.
    - WV imagery - the region downstream is moist (light); Behind the trough axis is dry (dark).
  - Troughs intersecting cloud bands
    - Baroclinic zone cloud system is present downstream from the intersection.
    - High and mid level clouds not present upstream.

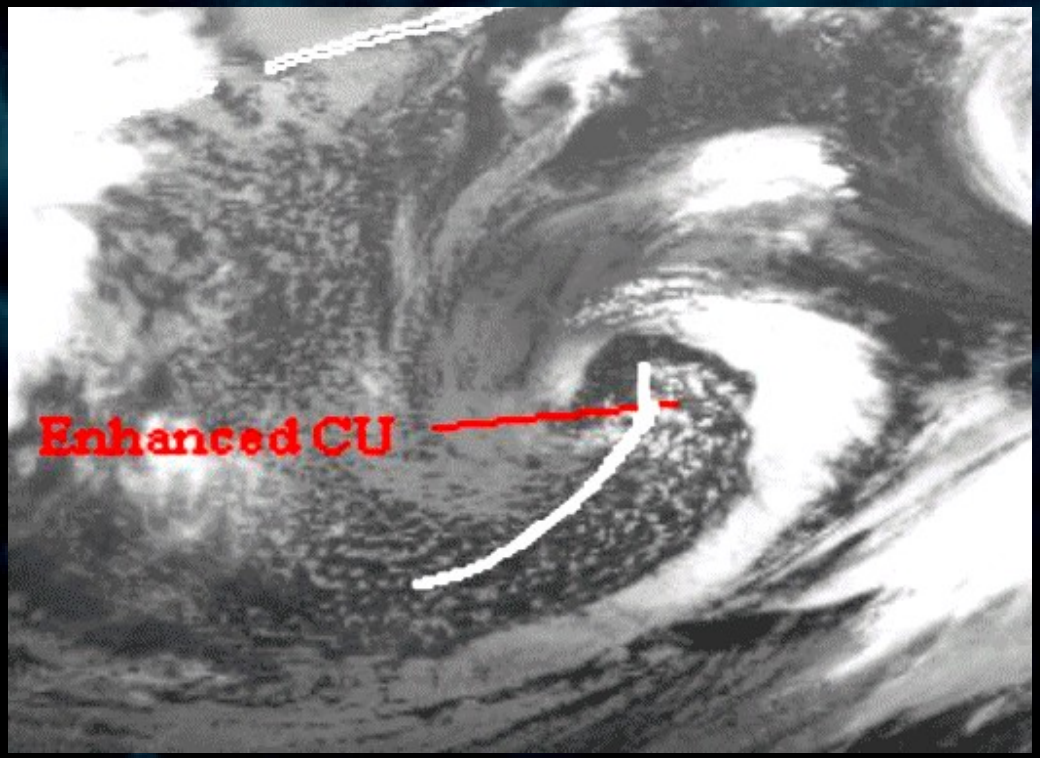
Locating Baroclinic Troughs



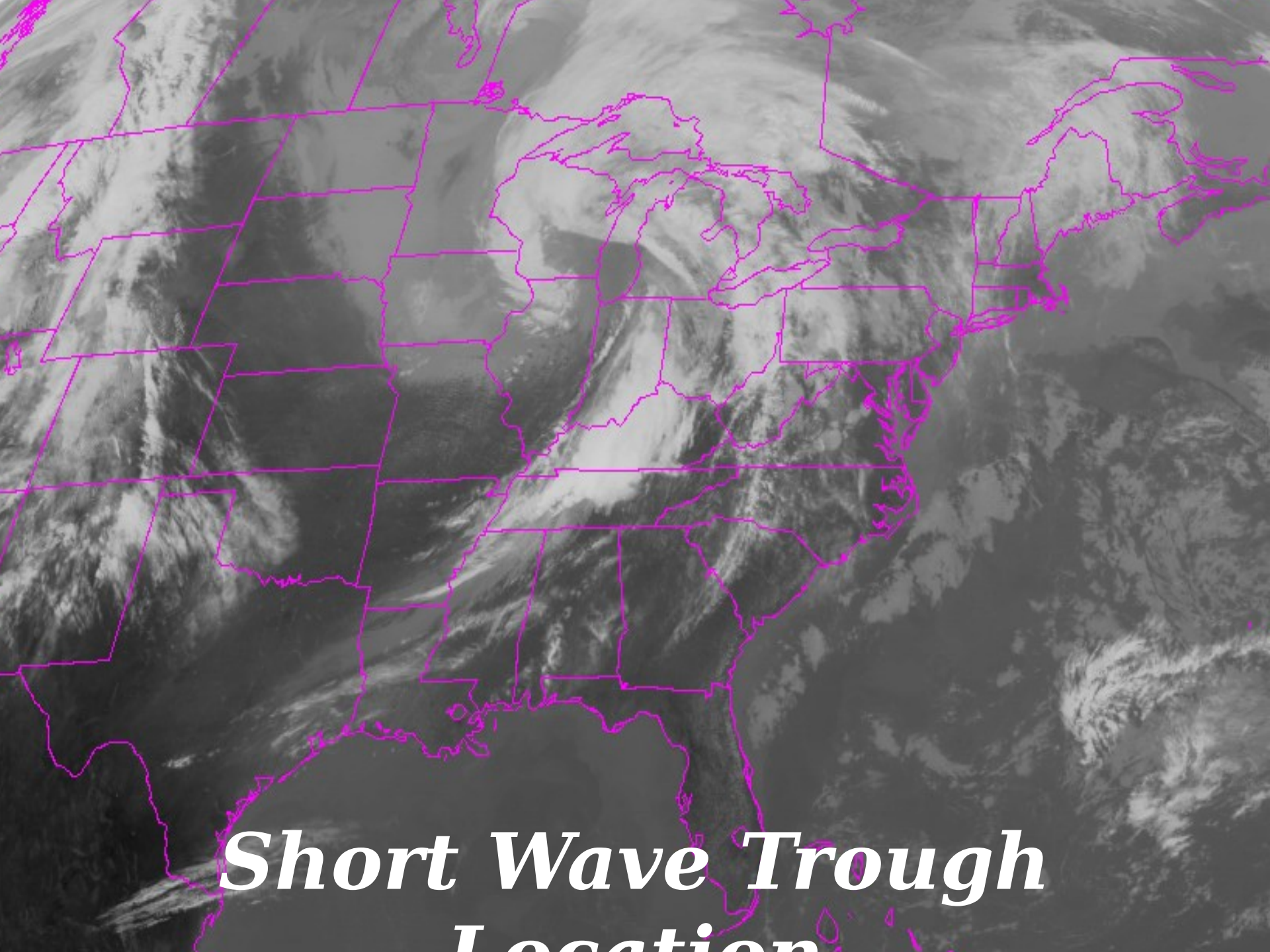


Locating Trough With Enhanced CU





Short Wave Trough
Location


Short Wave Trough
Location

Analysis of Upper-level Features

- Enhanced cumulus
  - Minor short-wave axis located upstream from the enhanced cumulus.
  - More common with troughs over water due to the availability of low-level moisture.
  - Takes on a comma shape with the upstream edge possessing an **“S” shape**.
- Cloud cluster moving over the ridge.
  - A minor short-wave trough moving over a long-wave ridge will appear as a small, unorganized cloud cluster.
  - May take on a comma shape in base of long-wave trough.

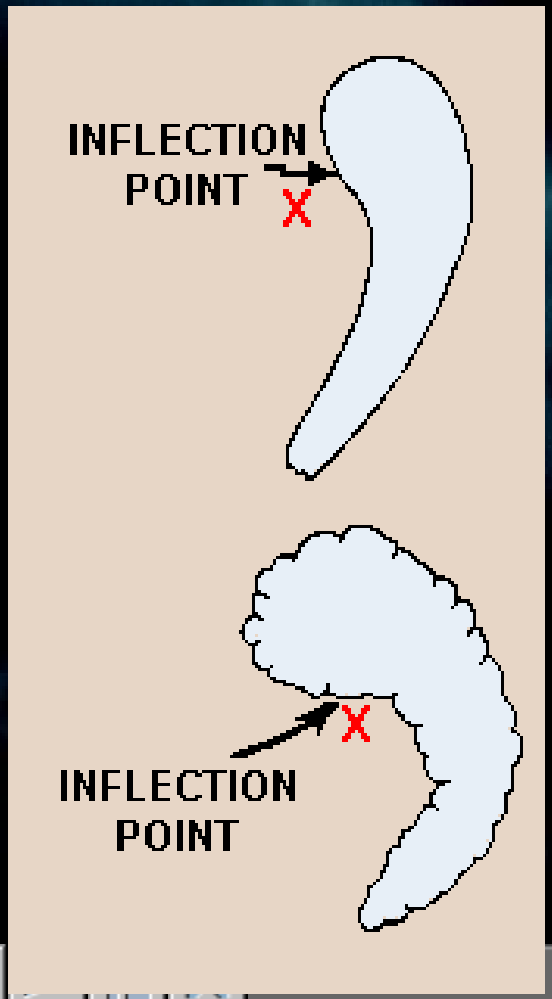
Analysis of Upper-level Features

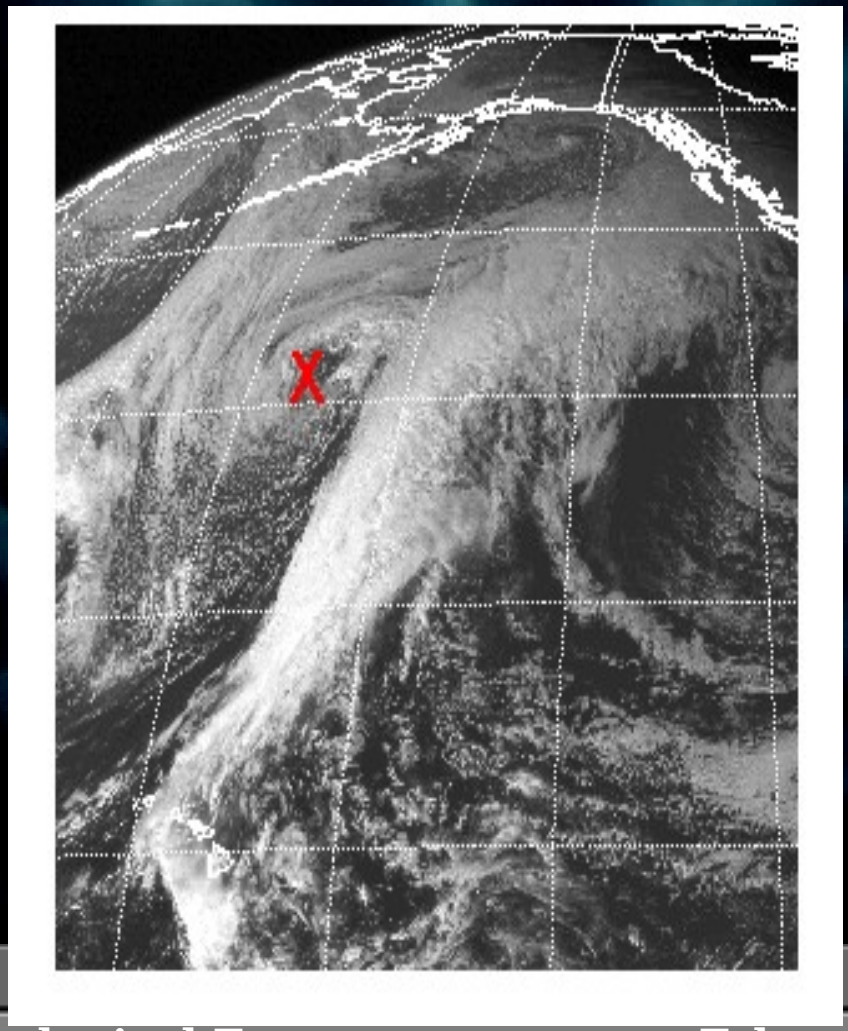
- Vorticity maximums
  - Cloudiness forms downstream from vorticity maxima.
  - In general, the vorticity maxima is located between the upper low center (if present) and the strongest winds.
    - Jet flowing northeastward, the vorticity maximum is east of the upper low.
    - Jet flowing southeastward, the vorticity maximum is west of the upper low.

Analysis of Upper-level Features

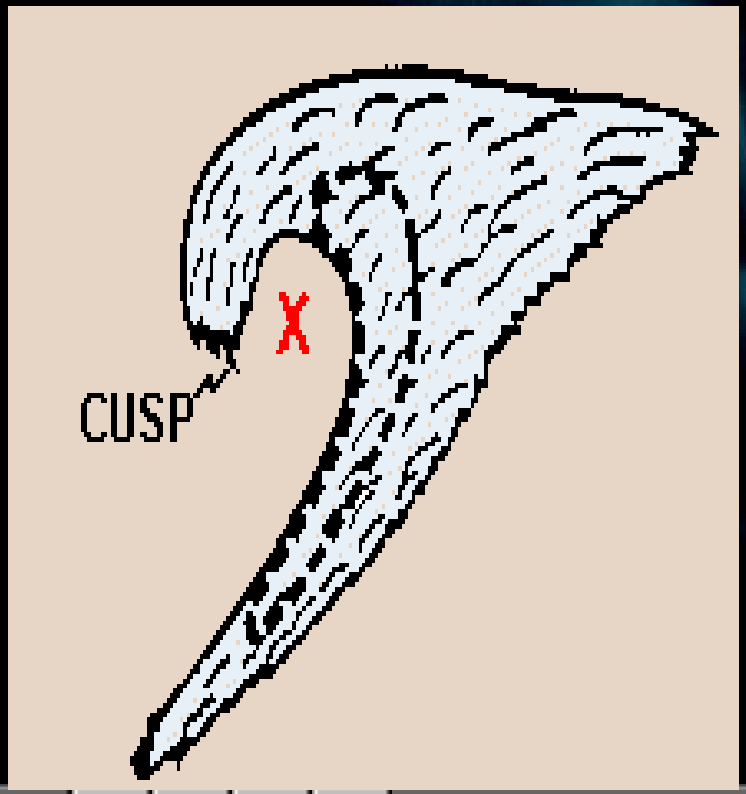
- Specific rules for locating vorticity maxima.
  - The vorticity maximum located approximately one degree into the clear air at the inflection point of the "S" shape on the upstream portion of the cloud shield.
  - The vorticity maximum is located approximately one degree in the clear air to the right of the cusp in the deformation zone clouds if comma cloud is hidden.
  - The vorticity maximum will be positioned the same for a rapidly translating comma cloud, however, it will be located more than 1˚ back in the clear air.

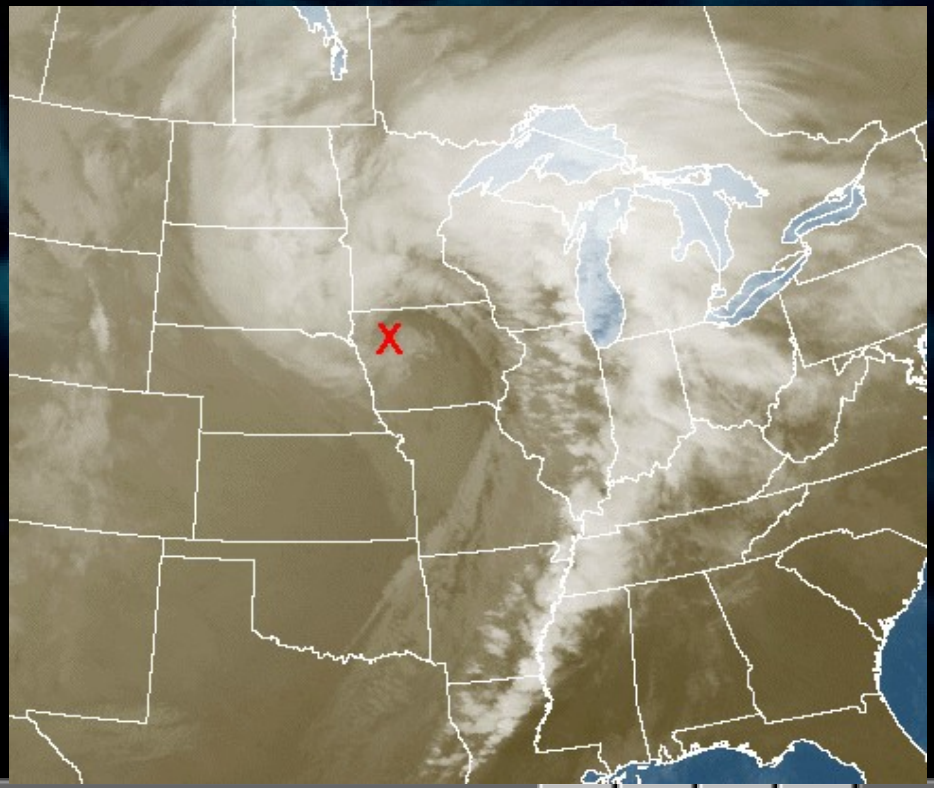
Locating Vorticity Maximas



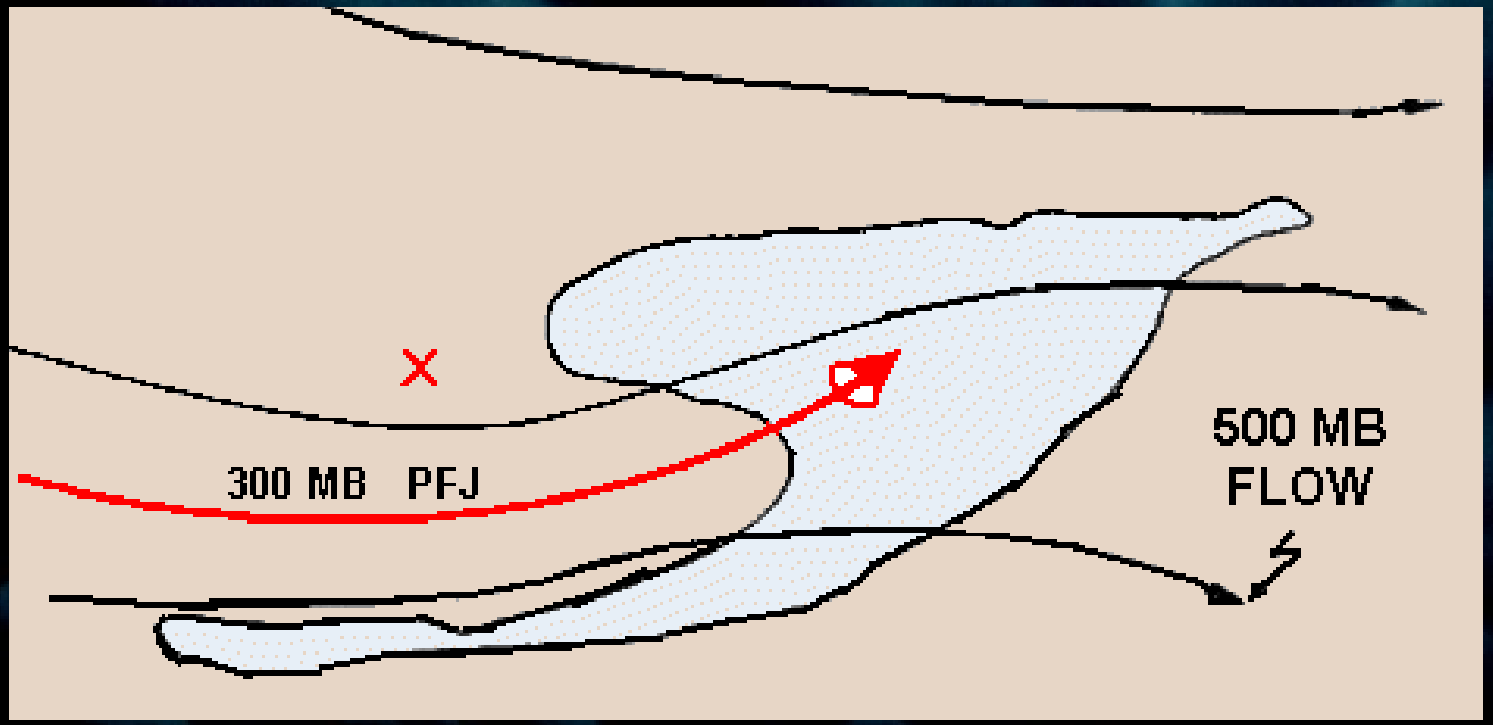


Hidden Vorticity Comma Cloud





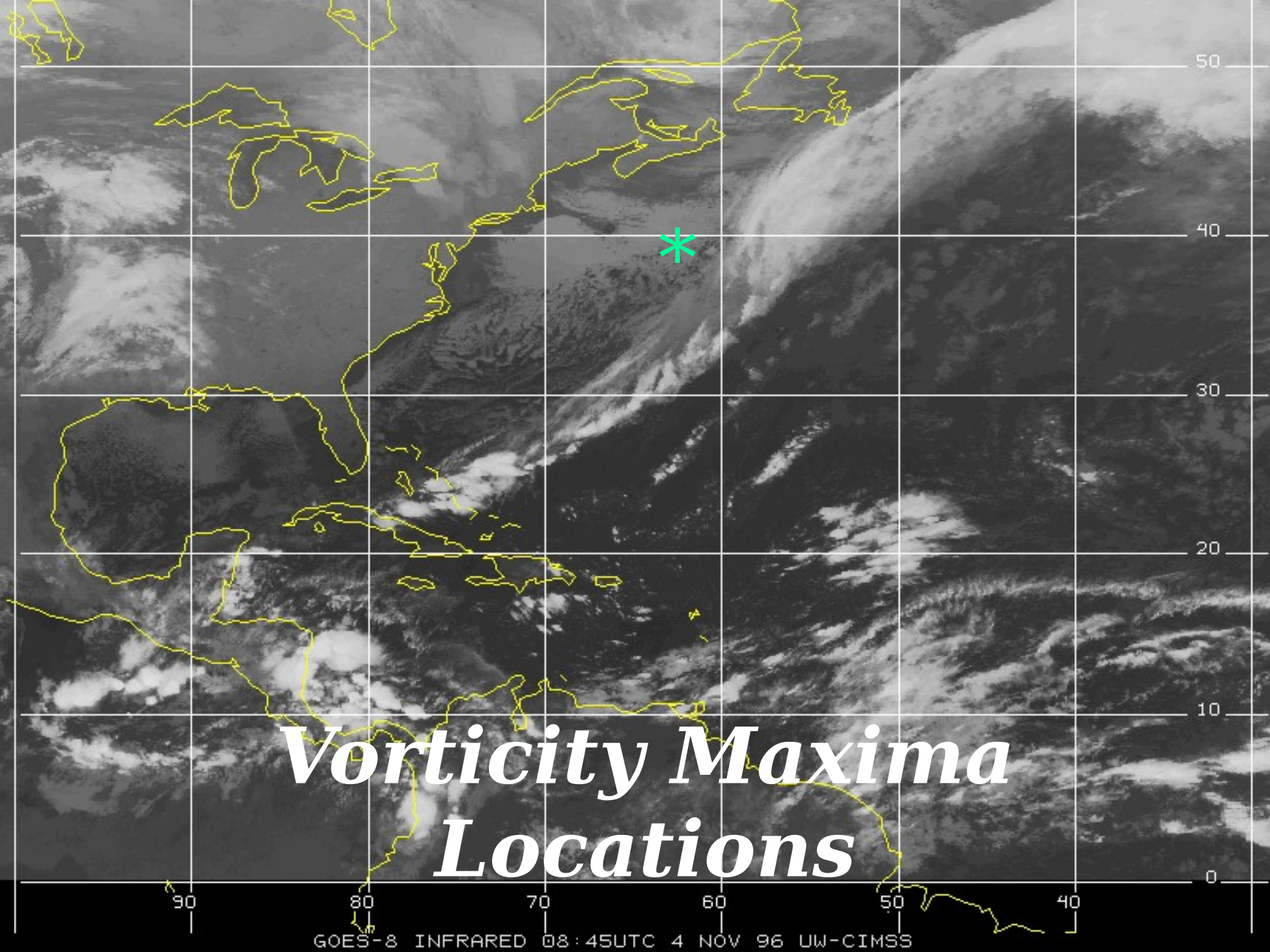
Rapidly Moving Vorticity Comma



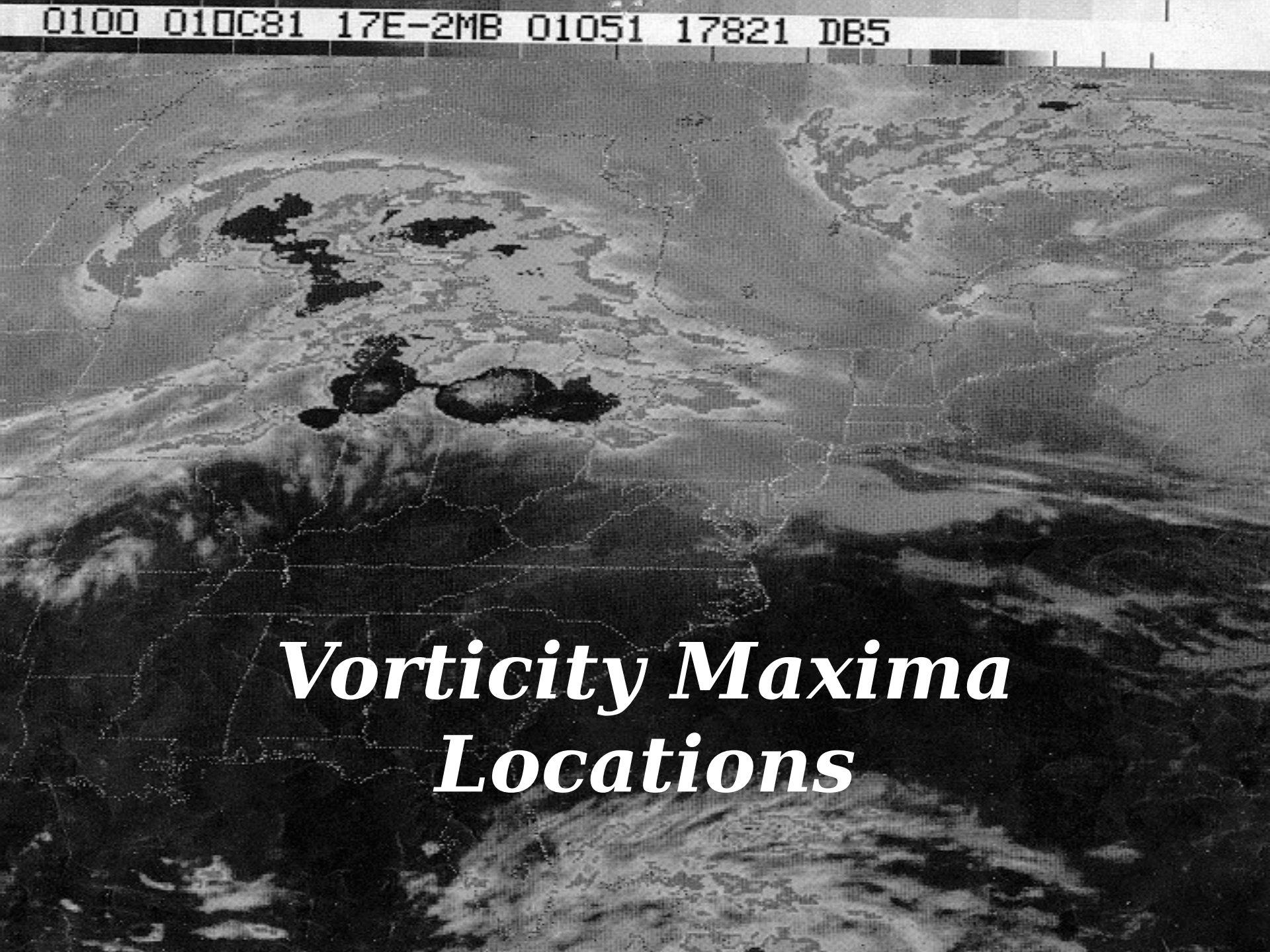
Vorticity Maxima
Locations

Analysis of Upper-level Features

- In general, small patches of cold cloud tops which are on the cyclonic side of the jet are indicators of a possible vorticity maximum.
  - Over water: Vorticity maxima located about 1˚upstream from the upstream edge of the clouds.
  - Over land: Vorticity maxima is located in the clear air, but further back due to the lack of moisture.



Vorticity Maxima Locations

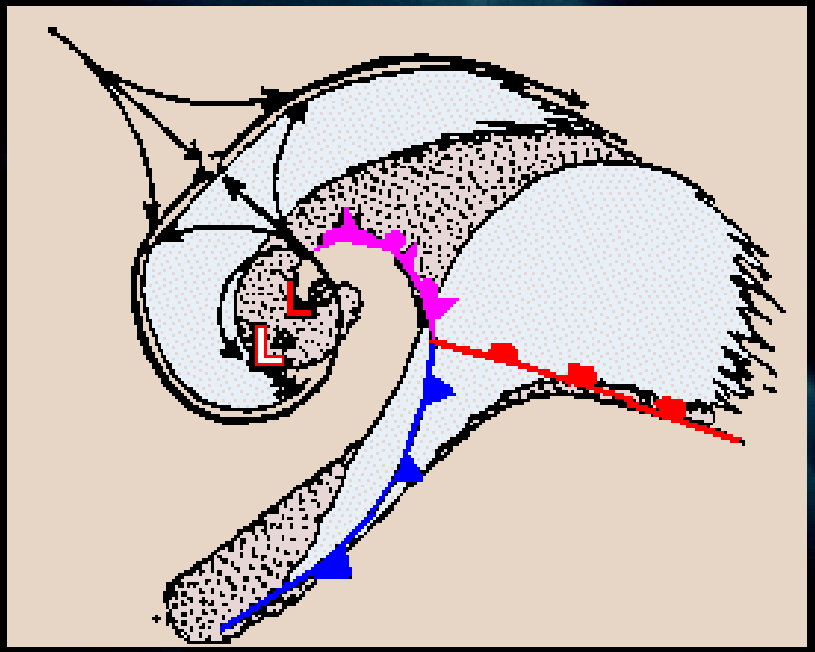


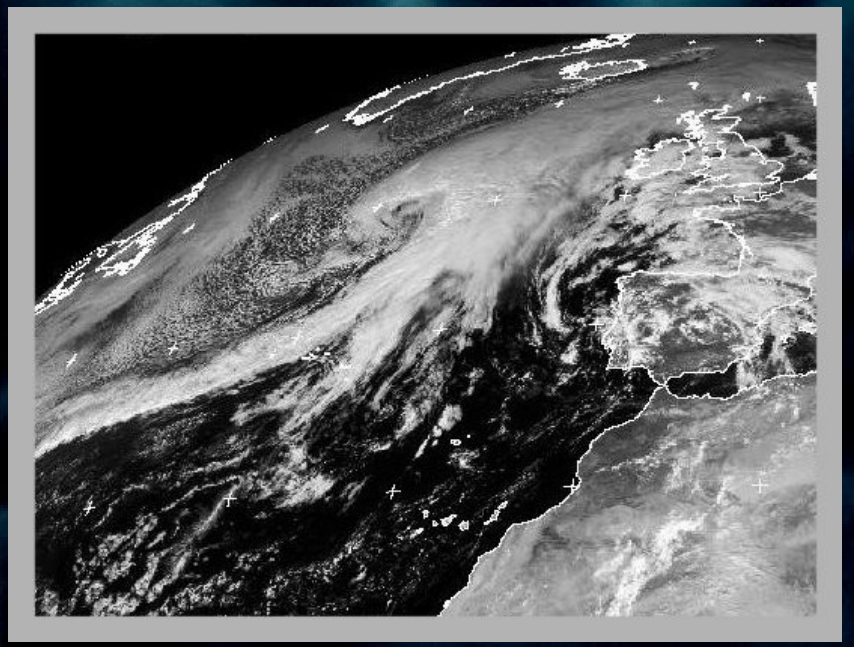
Vorticity Maxima Locations

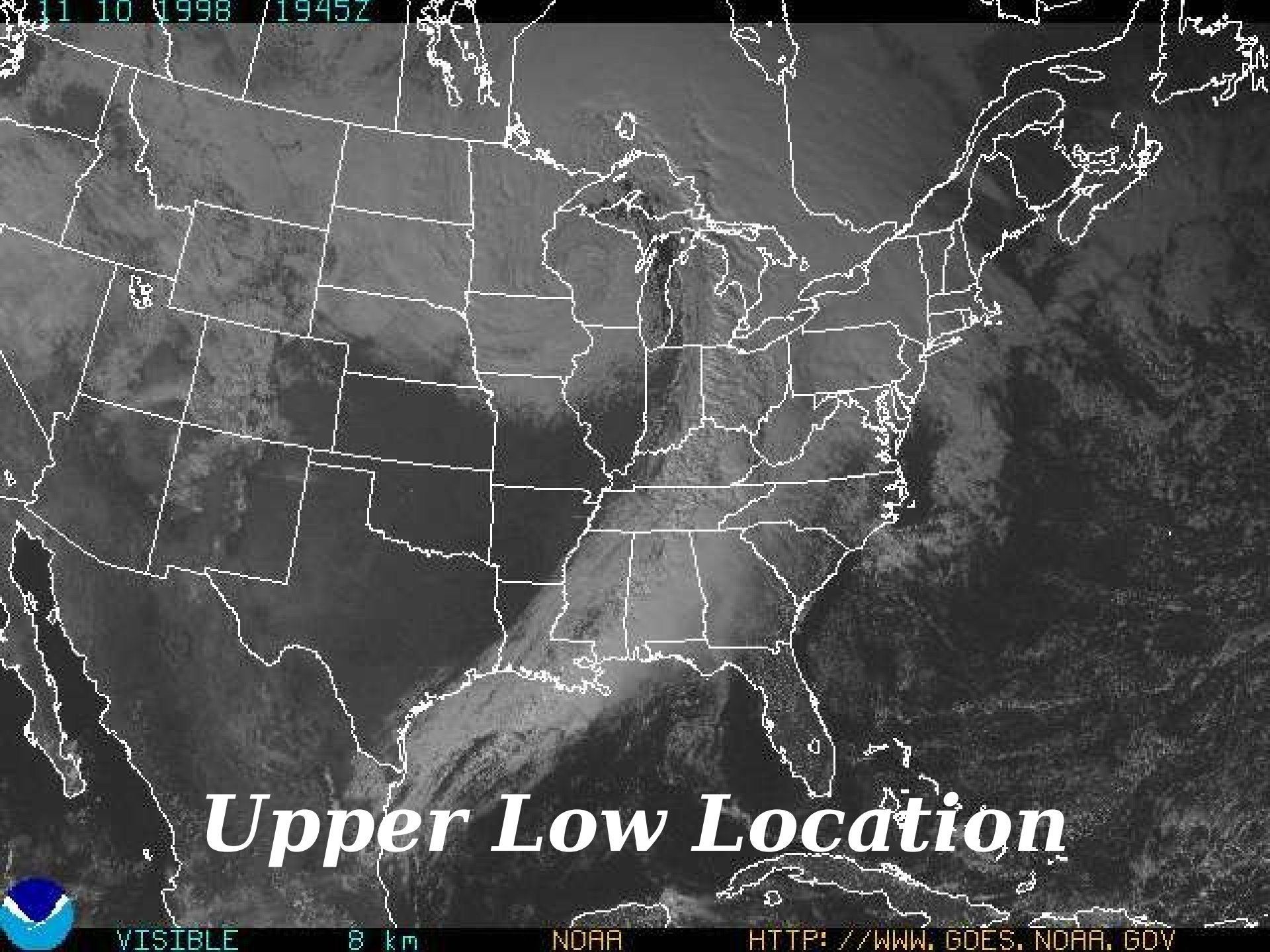
Analysis of Upper-level Features

- Upper-level lows
  - Upper-level lows associated with baroclinic lows at the surface.
    - System has a good vertical tilt.
    - The upper low is *located* at the cusp of the upper level deformation zone cloud system.
    - Water vapor imagery shows a dark slot spiraling around the low.

Baroclinic Upper Lows






11 10 1998 1945Z
Upper Low Location
VISIBLE 8 km NOAA HTTP://WWW.GOES.NOAA.GOV

11 10 1998 /1945Z
Upper Low Location
IR
8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

11 10 1998 /1945Z
Upper Low Location
IR
8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

2001 01DE86 38E-2MB 01314 20781 KB2
Upper Low Location

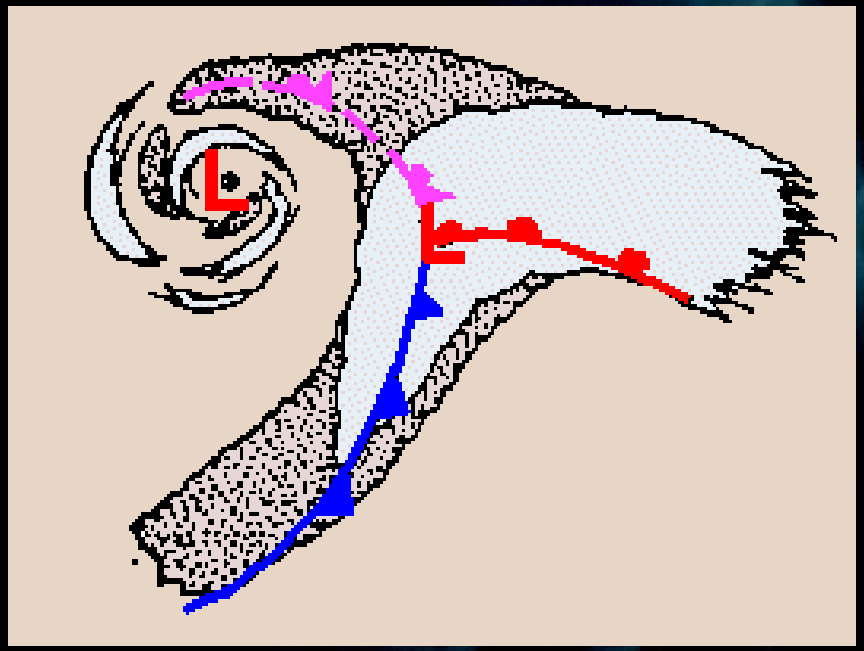
Analysis of Upper-level Features

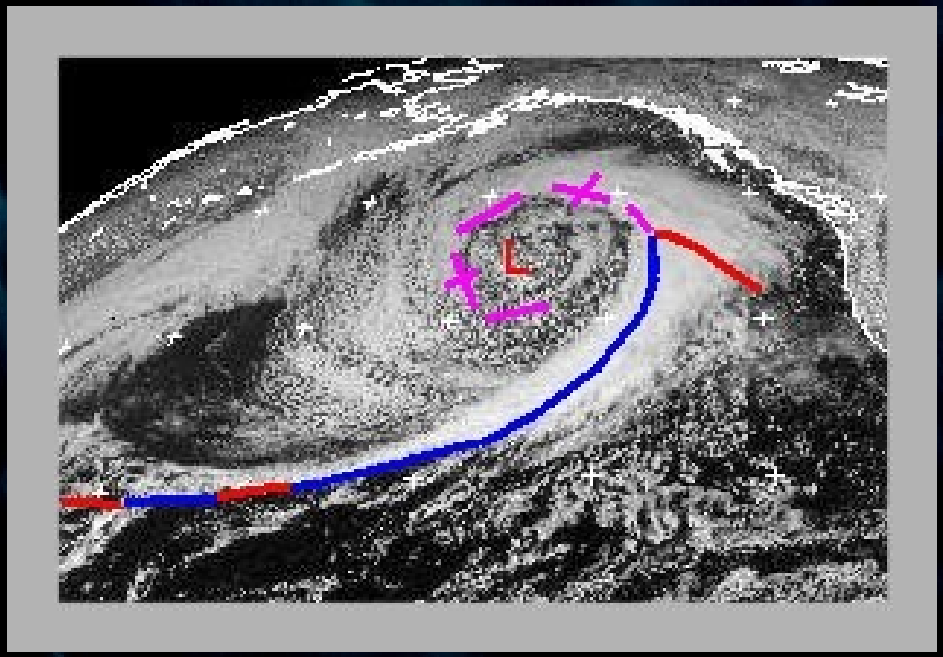
- Upper-level lows associated with dec aying waves

.

  - Cloud tops are fragmented and disorganized.
  - The upper low is located in the dry region "inside" the deformation zone.
  - Water vapor imagery indicates a dark band wrapped almost completely around the low.

Decaying Waves



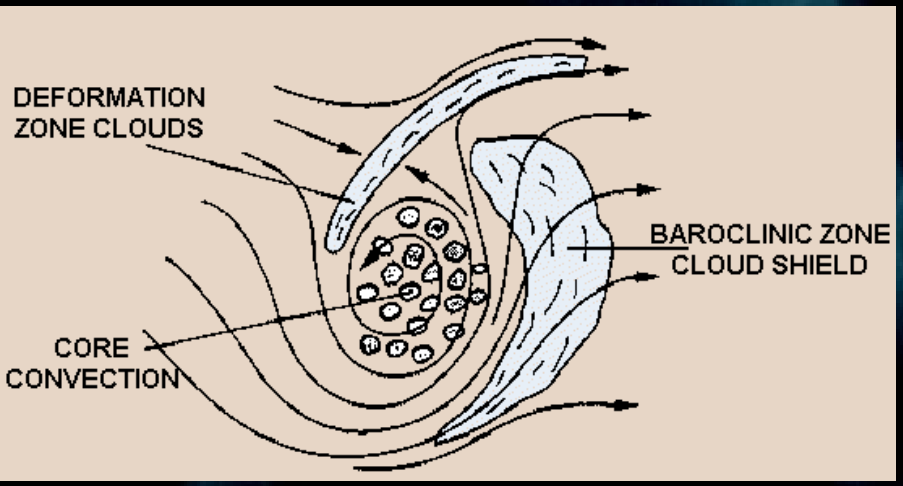


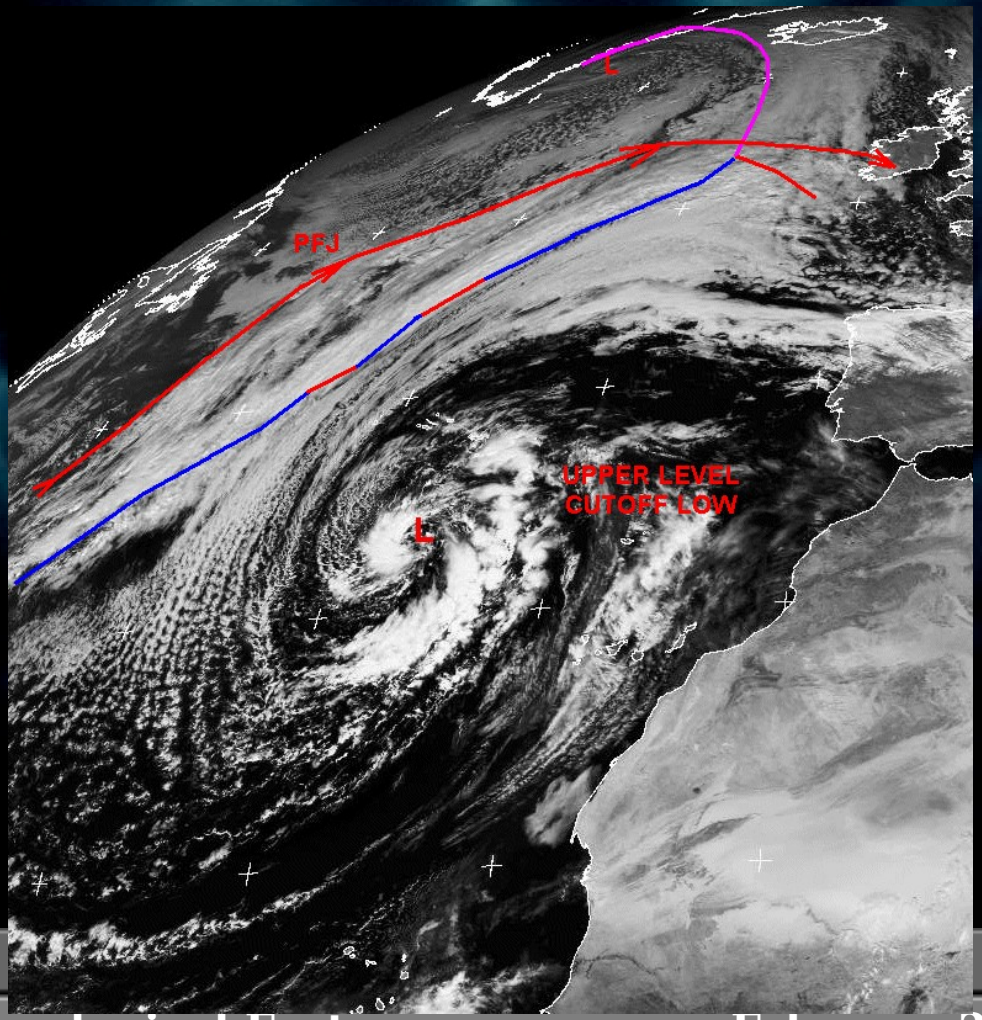
3 24 1999 0000Z
Upper Low Locations
IR
8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

Analysis of Upper-level Features

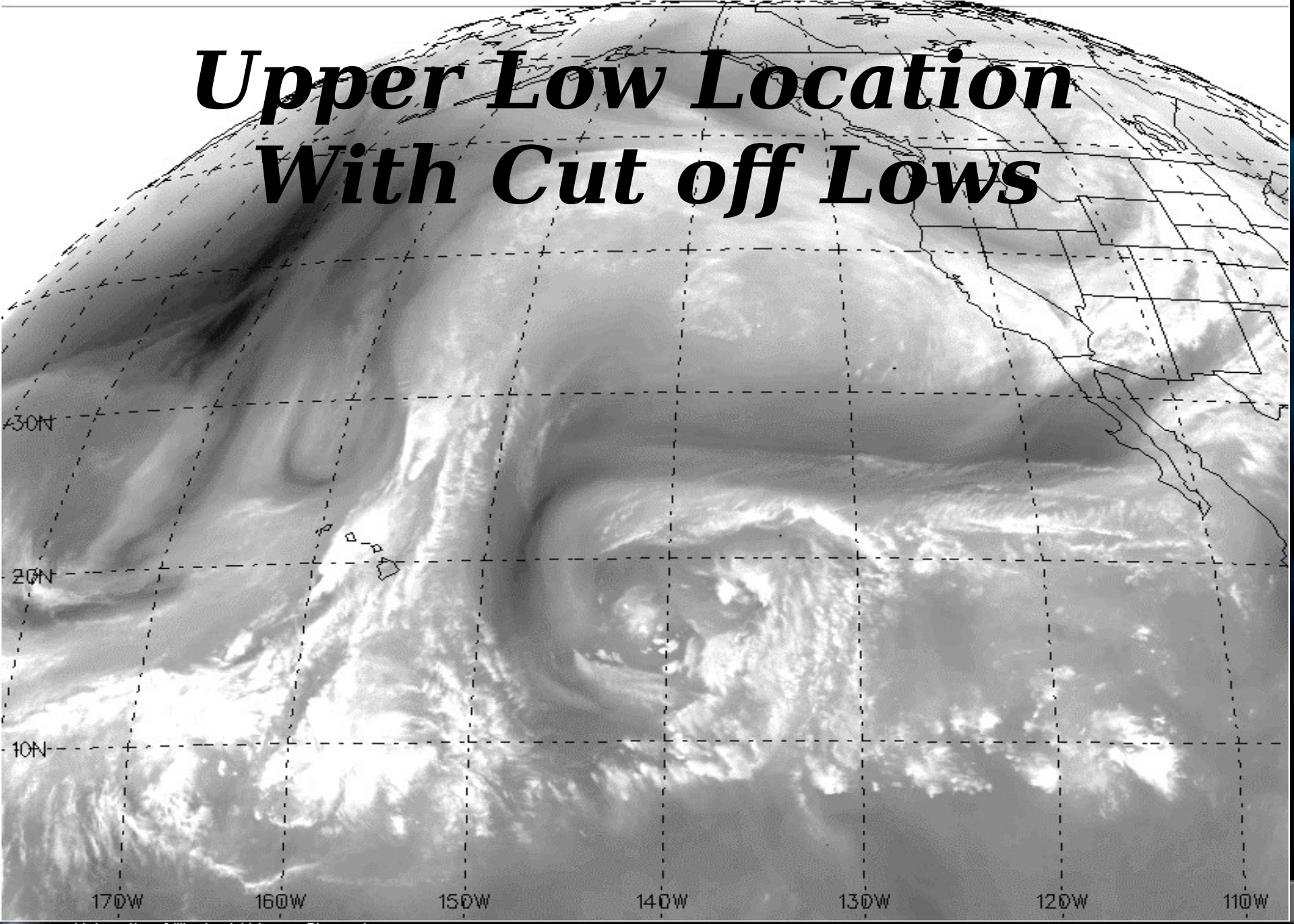
- Upper-level lows associated with cut-off lows
  .
  - Three types of cloudiness are normally associated with cut-off lows.
    - Baroclinic zone cirrus are normally found with the jet flowing southwest to northeast east of the low center.
    - Deformation zone cloud cirrus are bands of cirrus running east-west or southeast-northeast just north of the low.
    - Core convection
      - » Convective clouds located directly under the upper low.
      - » Core convection normally observed over water, unstable due to cold over warm, with the coldest air is at the center.

Cut-off Lows


DEFORMATION
ZONE CLOUDS
BAROCLINIC ZONE
CLOUD SHIELD
CORE
CONVECTION


L
PFJ
UPPER LEVEL
CUTOFF LOW
L

Upper Low Location With Cut off Lows



University of Illinois at Urbana-Champaign
Department of Atmospheric Sciences
http://www.atmos.uiuc.edu/

GOES9 Pacific/Western Water Vapor Image
November 14, 1996 22GMT

11 12 1999 2200Z
Upper Low Location
With Cut off Lows
WATER VAPOR 8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

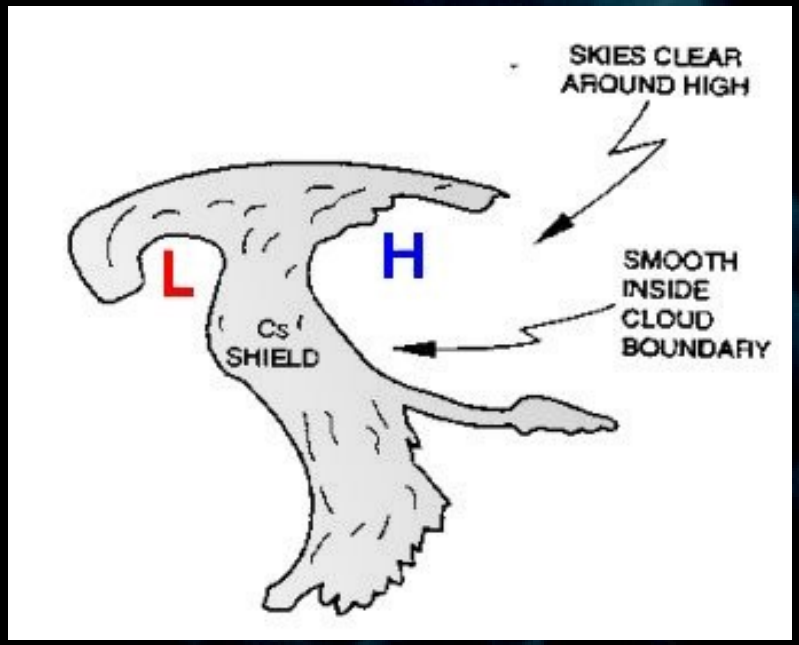
Analysis of Upper-level Features

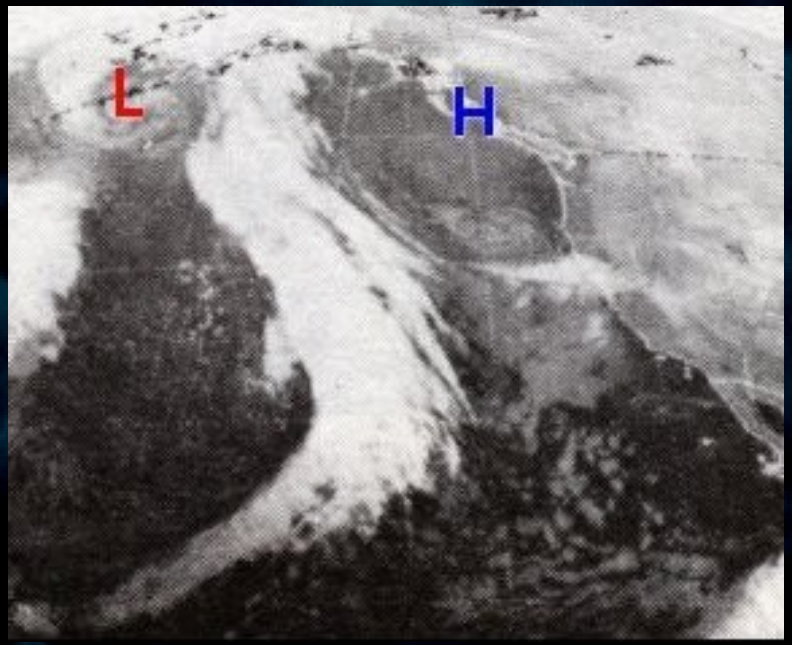
- Water vapor imagery indicates a dark band spiraling around low.
- Life cycle of a cut-off low
  - » Initial conditions - deepening positively tilted long wave trough.
  - » Development - upstream ridge builds due to WAA, while the long wave trough deepens due to CAA. CeF and CGF become stronger than CoF causing mass to deflect towards lower heights. PFJ becomes more high zonal, "cutting off" the low.
  - » Dissipation/change in character - loss of mass eventually dissipates the low, or a major short wave trough could "**kick out**" the low.

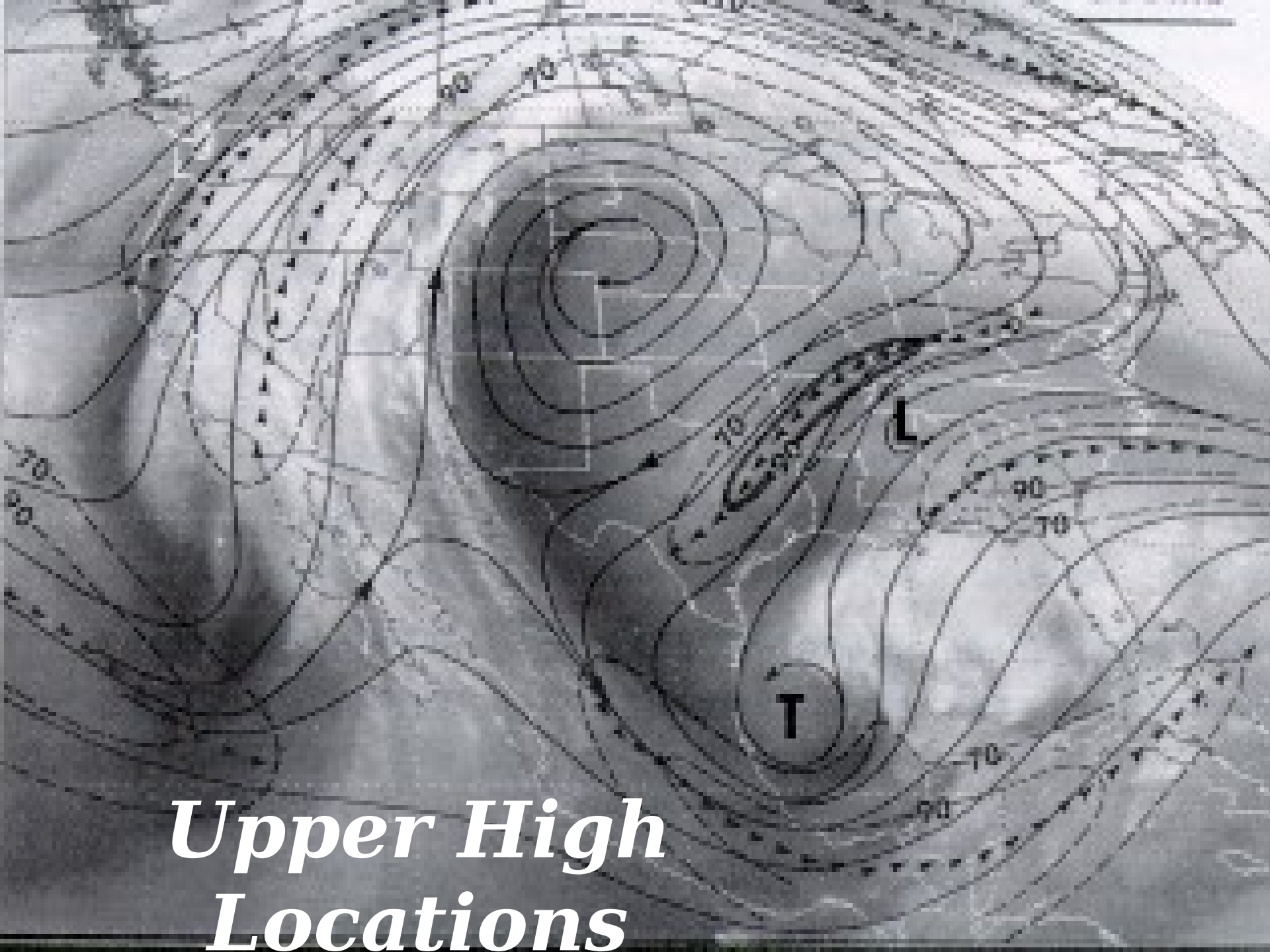
Analysis of Upper-level Features

- Upper-level highs
  - Upper highs are difficult to position; VIS and IR sometimes useful.
  - Use of water vapor imagery (most useful).
    - WV imagery indicates a boundary between moist air to the west and drier air to the east with a long-wave ridge.
    - Inside boundary becomes smooth with developing high.
    - The dark side of the boundary will darken further as anticyclonic circulation strengthens.

Locating Upper-level Highs

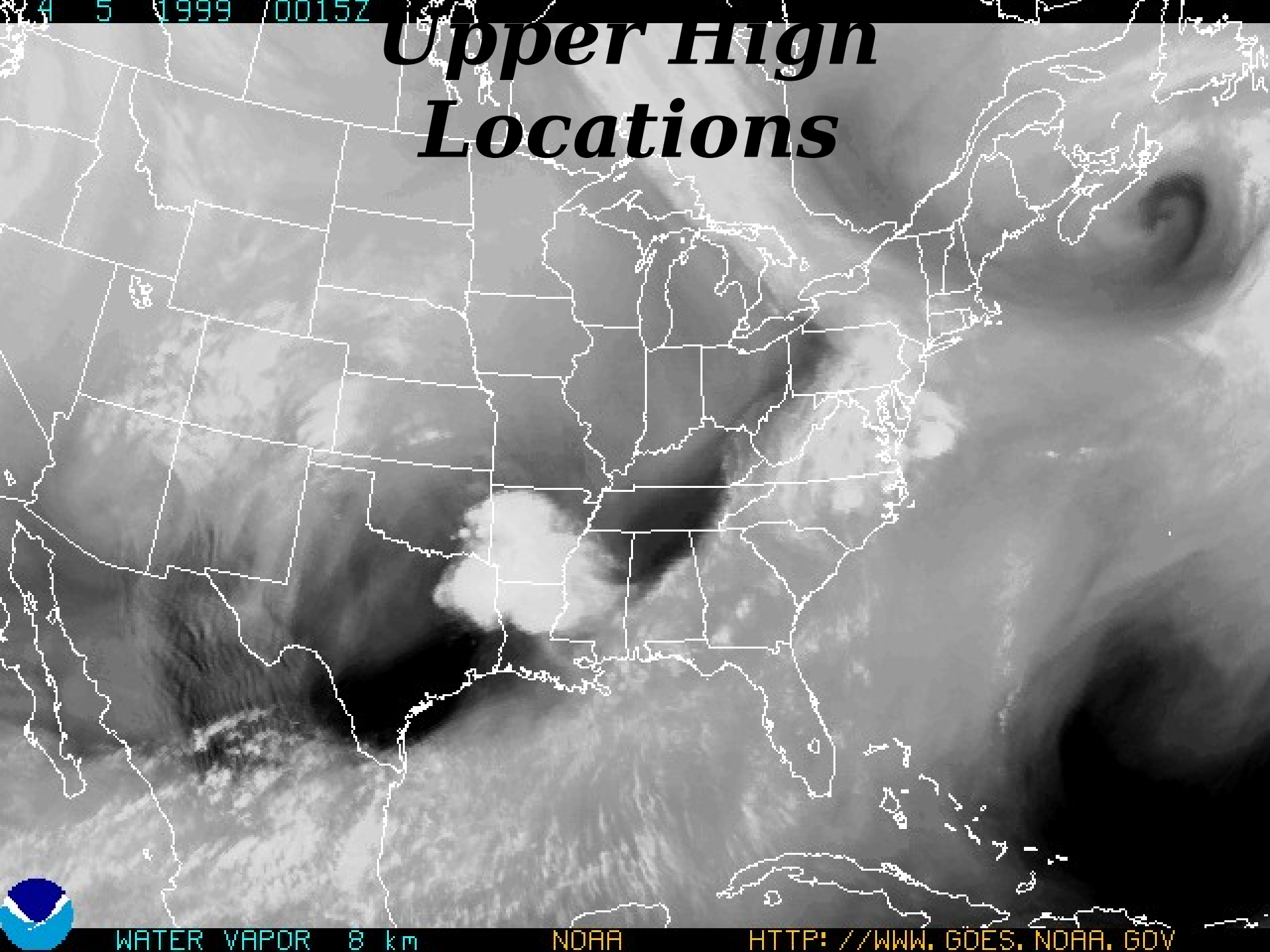






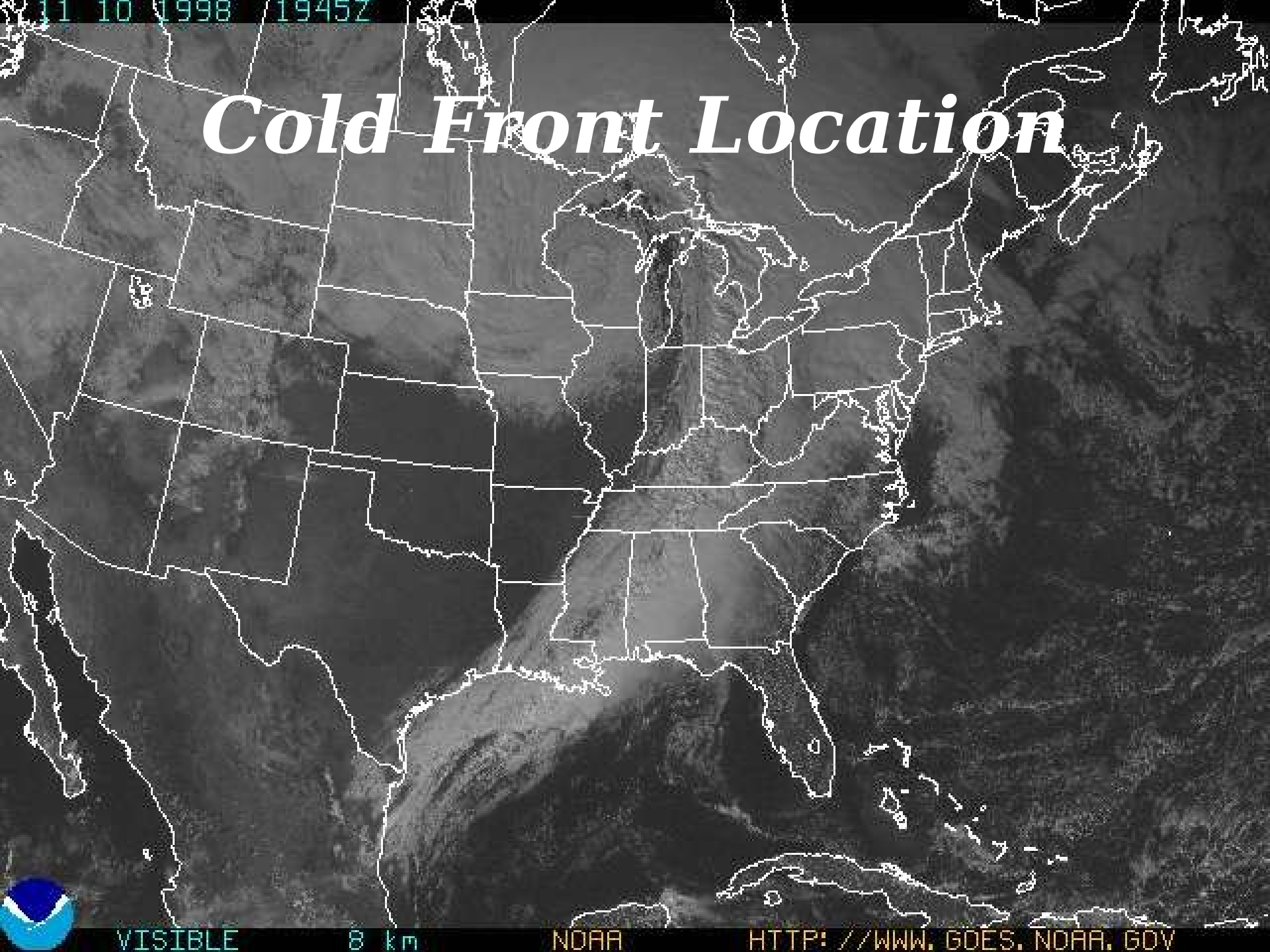
Upper High Locations

Upper High Locations

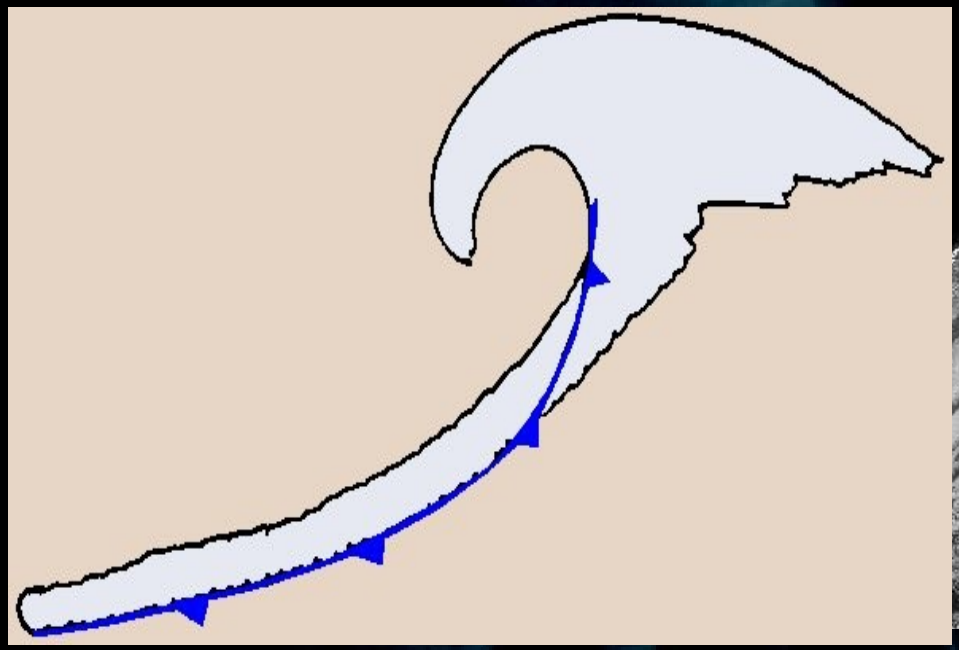


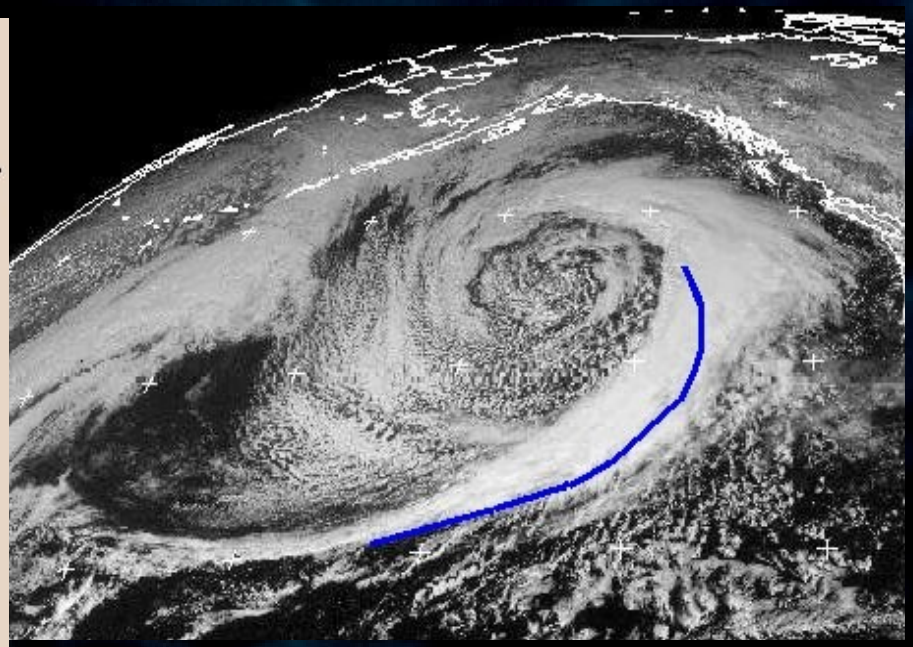
Analysis of Low Level Features

- Fronts
  - Cold fronts
    - A cold front is usually located under the multi-layered, baroclinic zone cloud system.
    - Near the low center, placement depends on the type of front.
      - Active cold front
        - » Front placed on the -n side of cloud band.
        - » Clouds on VIS imagery appear smoother; On IR they are colder (higher).
        - » The jet stream is more parallel to the front.


11 10 1998 1945Z
Cold Front Location
VISIBLE 8 km NOAA HTTP://WWW.GOES.NOAA.GOV

Active Cold Front



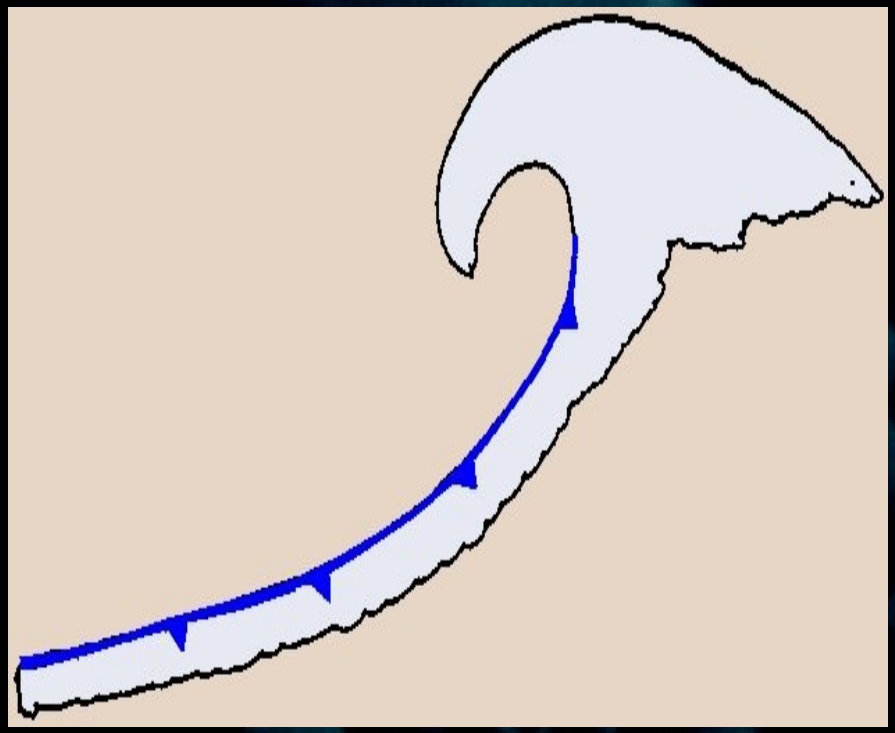


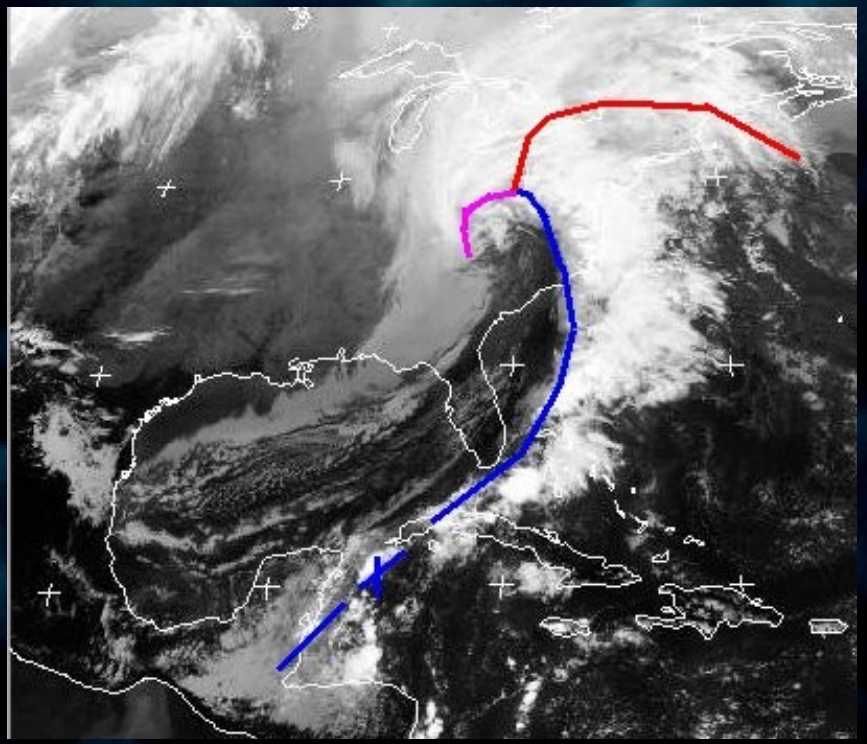
11 10 1998 /1945Z
Cold Front Location
IR
8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

Analysis of Low Level Features

- Inactive cold front
  - Front placed on +n side of cloud band.
  - Clouds on VIS imagery are lumpier with more texture; On IR they are warmer (lower).
  - The jet stream approaches the front at a steeper angle.

Inactive Cold Front

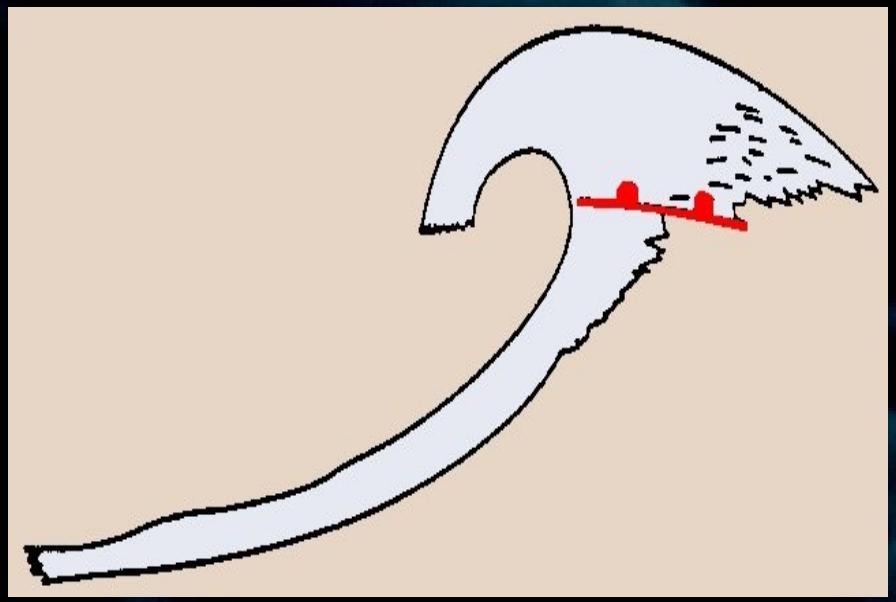


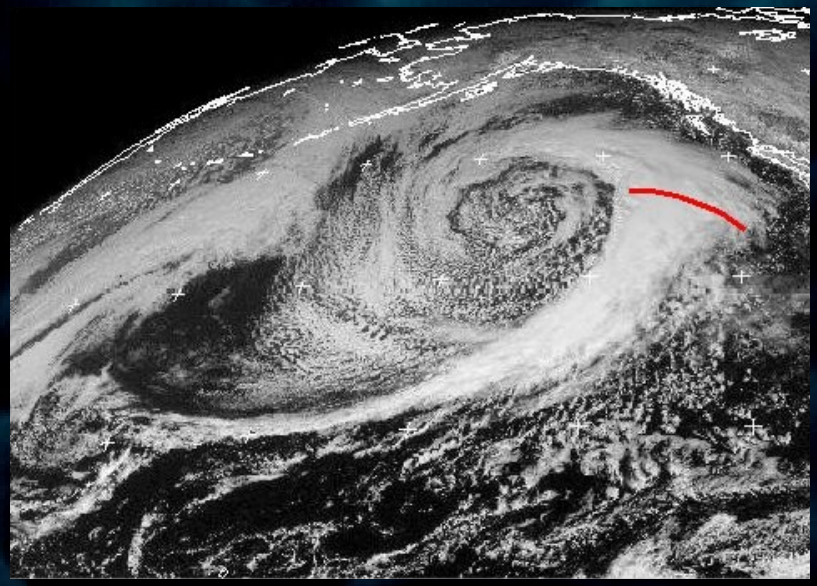


Analysis of Low Level Features

- Warm fronts
  - Difficult to place; Look for **notch or wedge**.
  - Low cloud band (formed from warm moist air ascending the frontal slope).
  - If no notch is present, place the front before greatest cloudiness. This cloudiness is formed by warm moist air ascending the warm frontal slope.

Warm Fronts





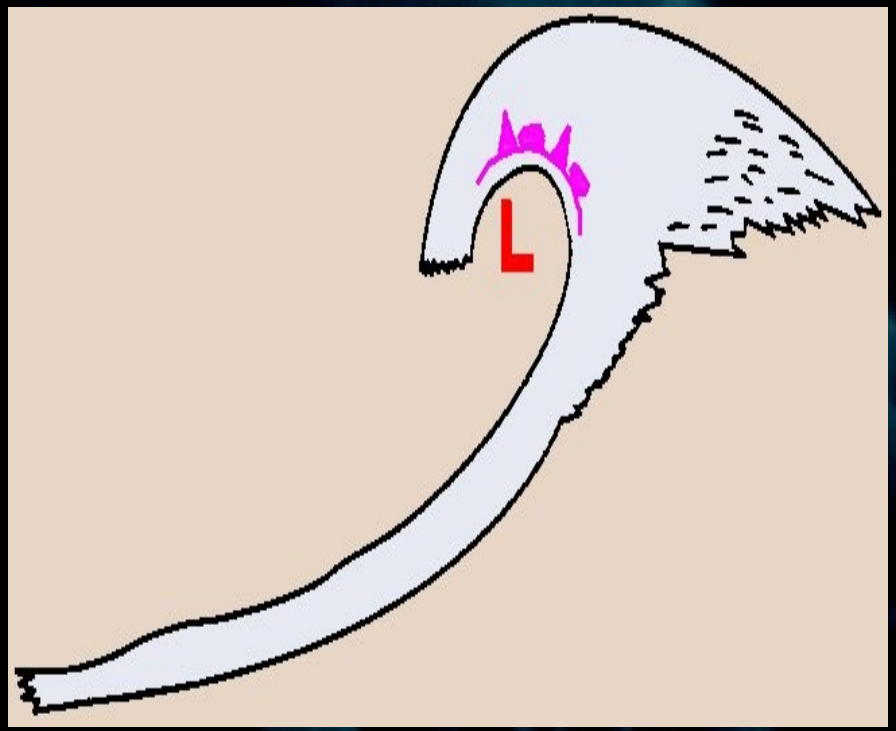
11 10 1998 1945Z
Warm Front Location
VISIBLE 8 km NOAA HTTP://WWW.GOES.NOAA.GOV

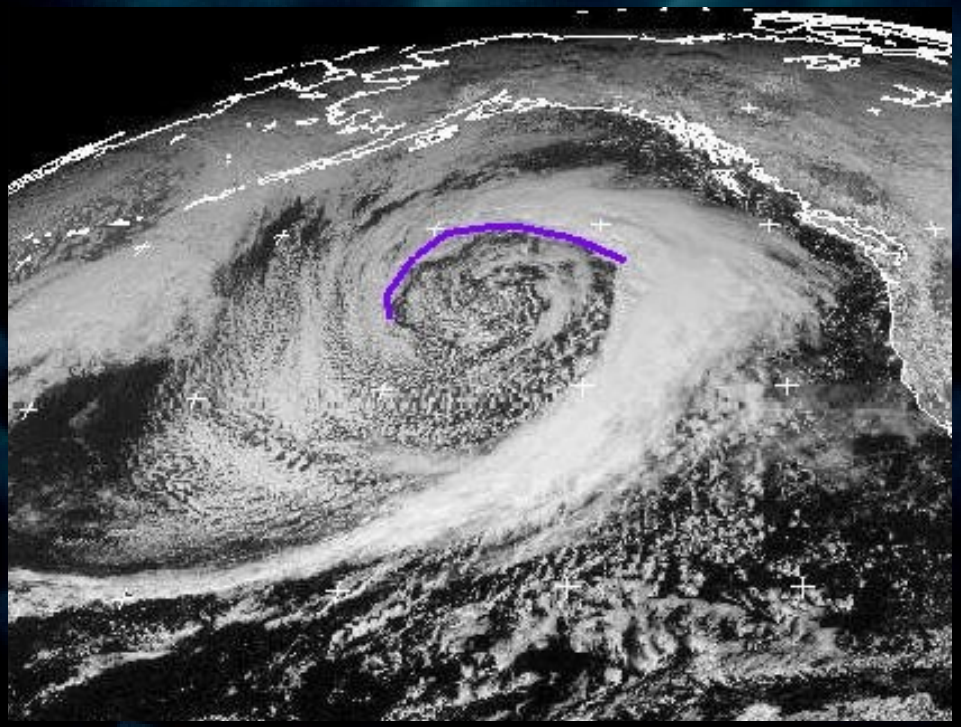
11 10 1998 /1945Z
Warm Front Location
IR
8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

Analysis of Low Level Features

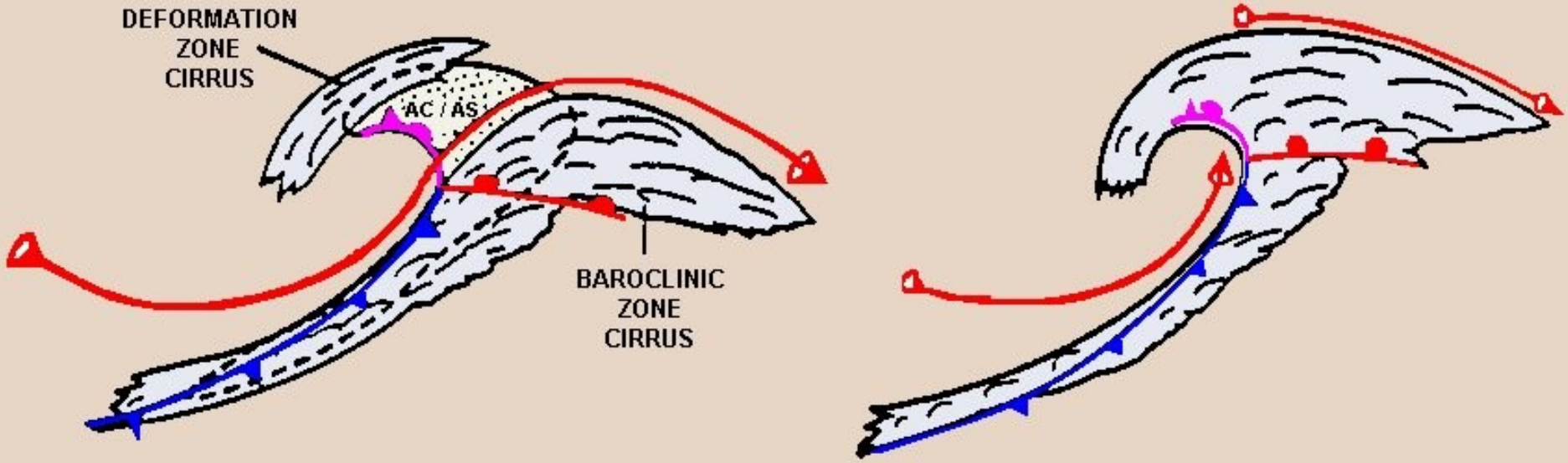
- Occluded fronts
  - Located along the back edge of the low clouds in comma cloud head
    .
  - Triple point placement
    - Type A system is located on -n side of baroclinic boundary near the back of the upstream cloud edge.
    - Type B system is often **hard** to locate and must interpolate where warm front and cold front meet.

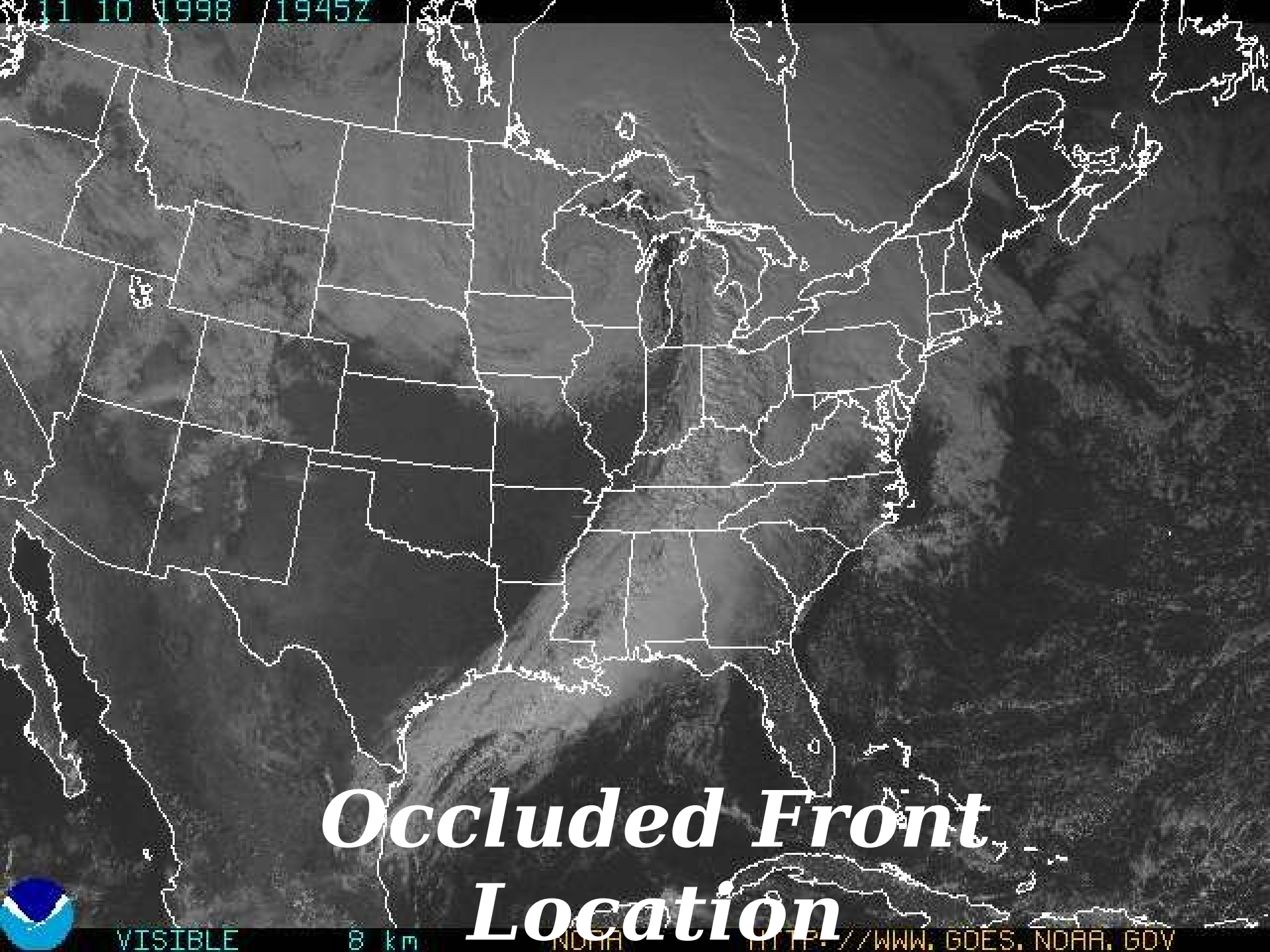
Occluded Fronts

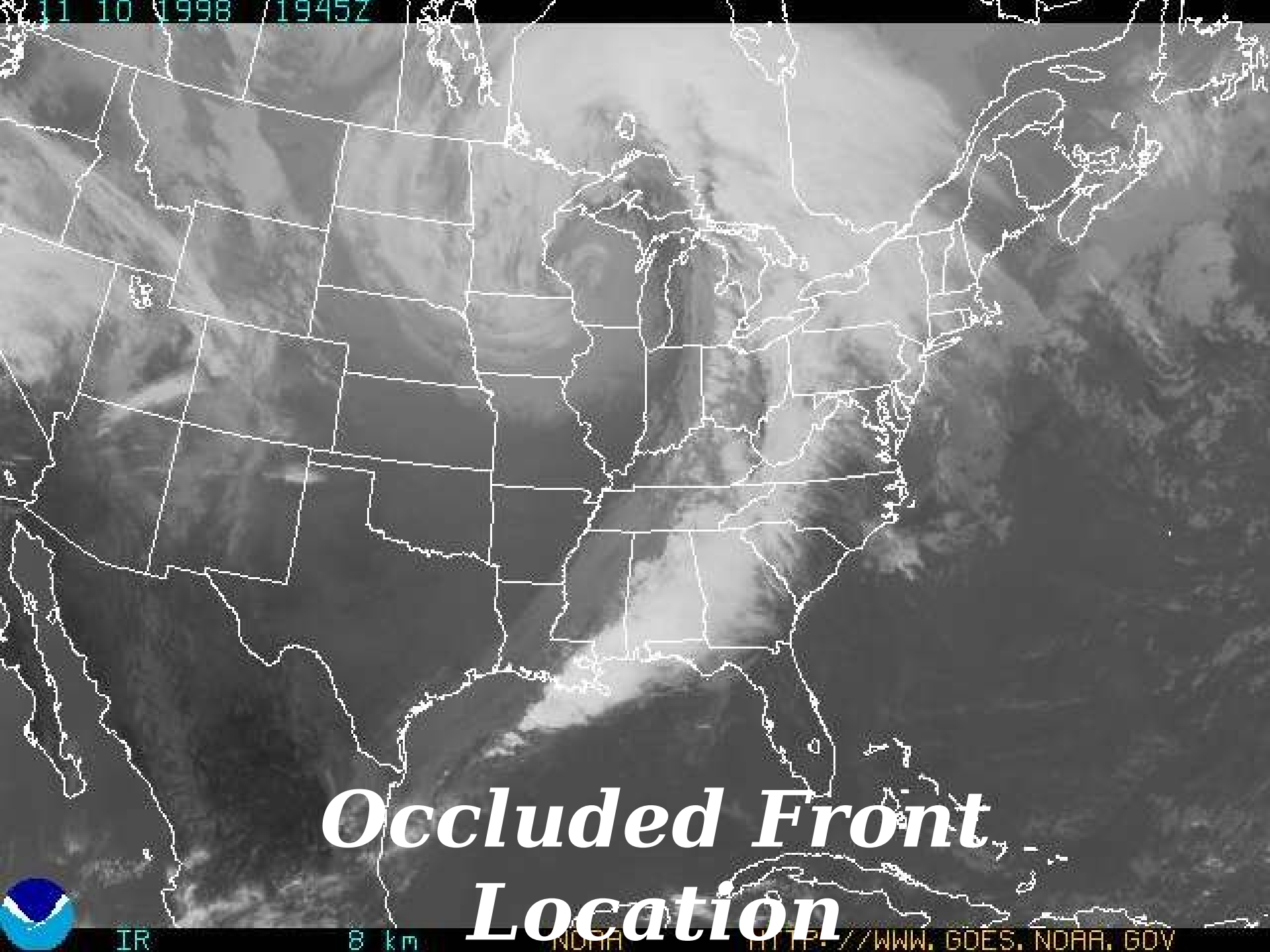




Type A & B



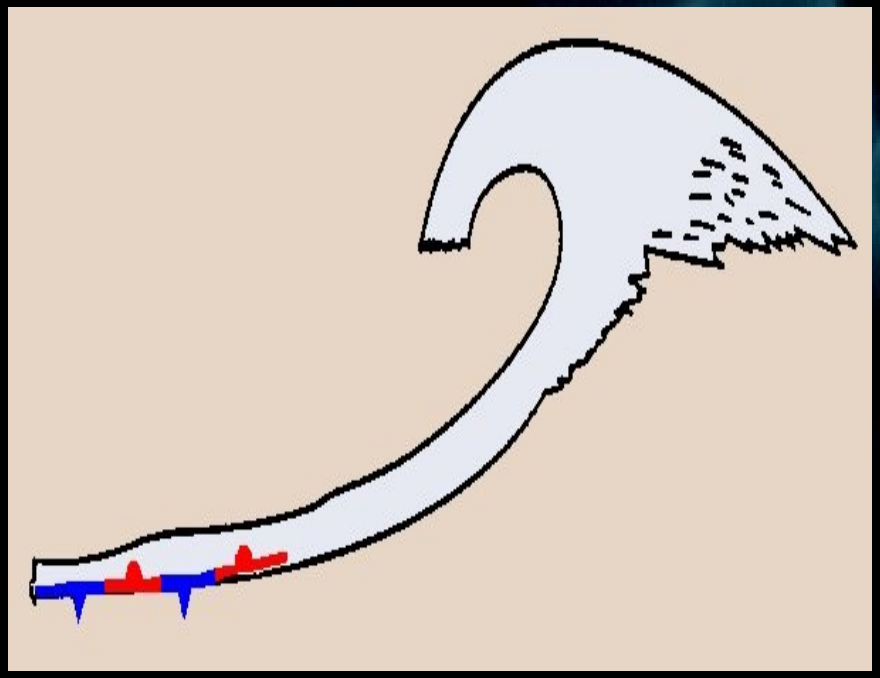

11 10 1998 1945Z
Occluded Front Location
VISIBLE 8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

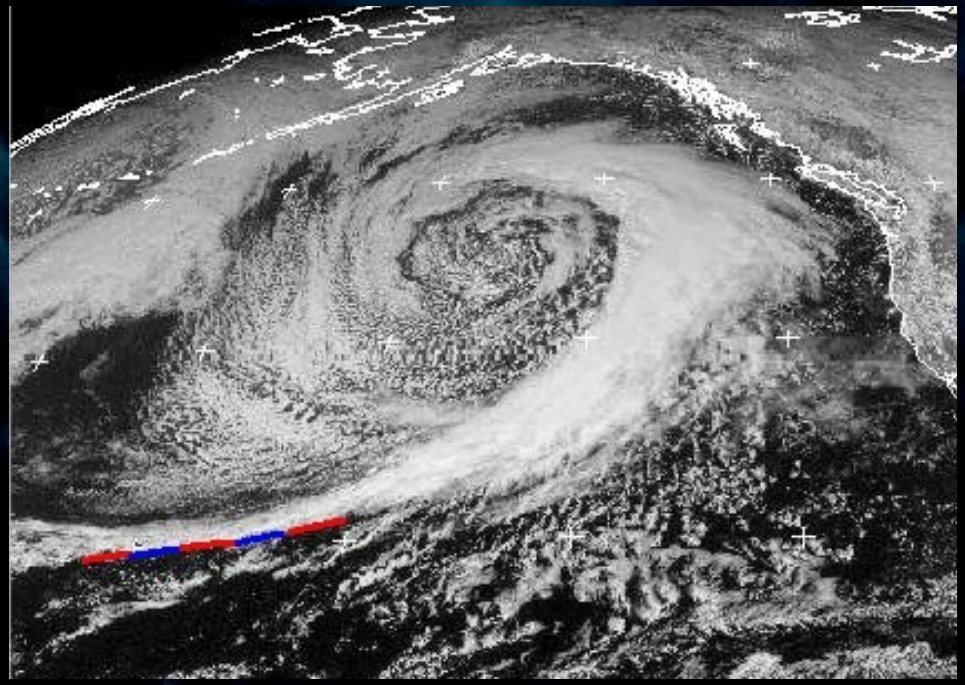

11 10 1998 /1945Z
Occluded Front
Location
IR
8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

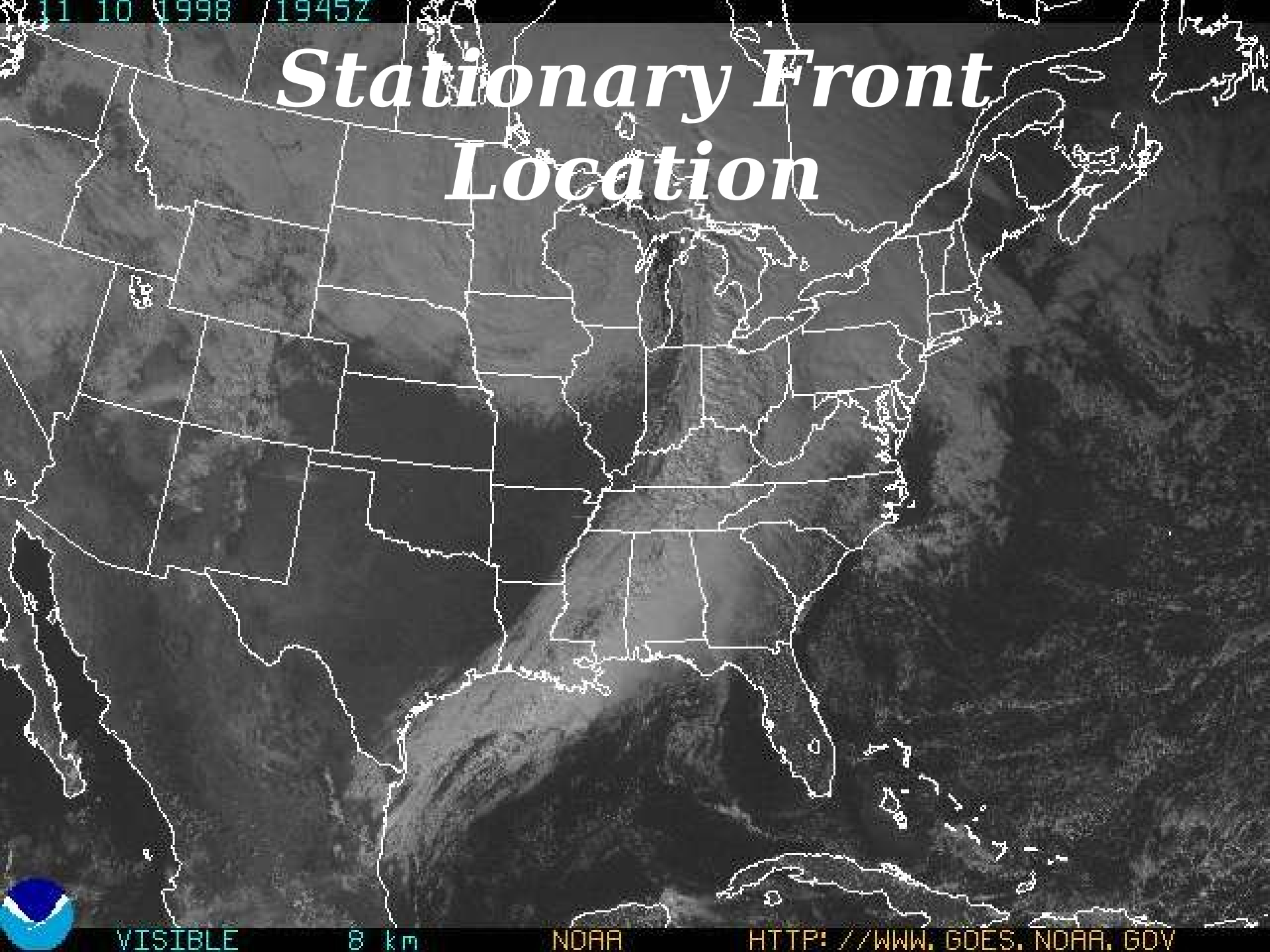
Analysis of Low Level Features

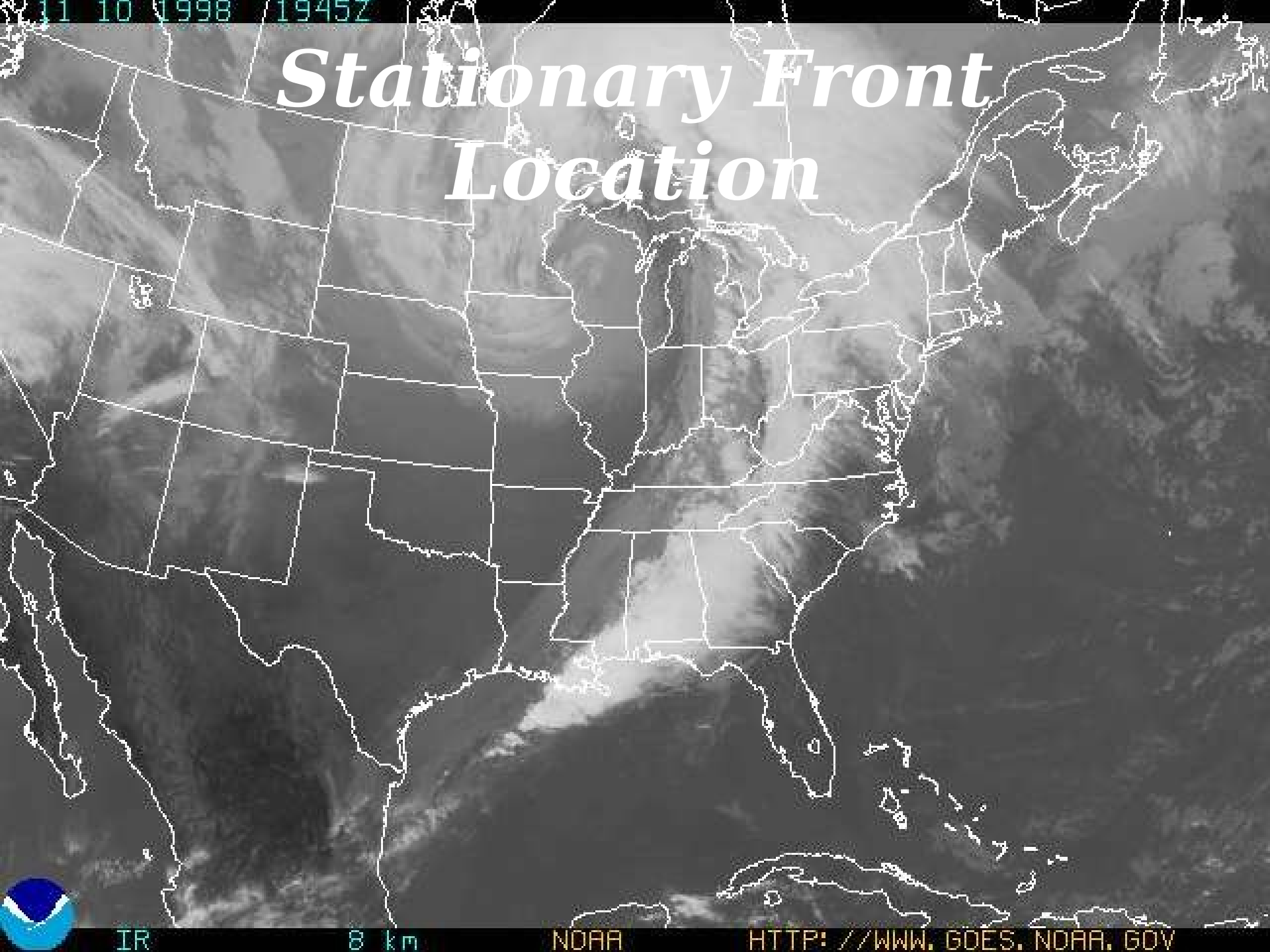
- Stationary fronts
  - Location along the southern edge of the frontal cloud band
    . Over water it is found near the low-level deformation zone.
  - Clouds
    - Cumuliform on the warm air side.
    - On the cold side, the type of clouds depends upon the stability of the overlying warm air.

Stationary Fronts





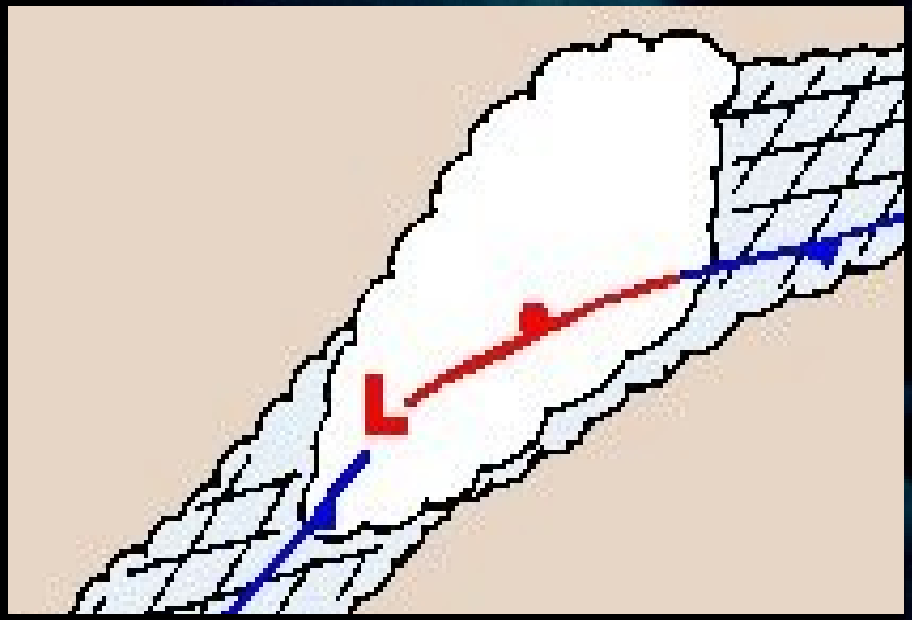

11 10 1998 1945Z
Stationary Front Location
VISIBLE 8 km NOAA HTTP://WWW.GOES.NOAA.GOV

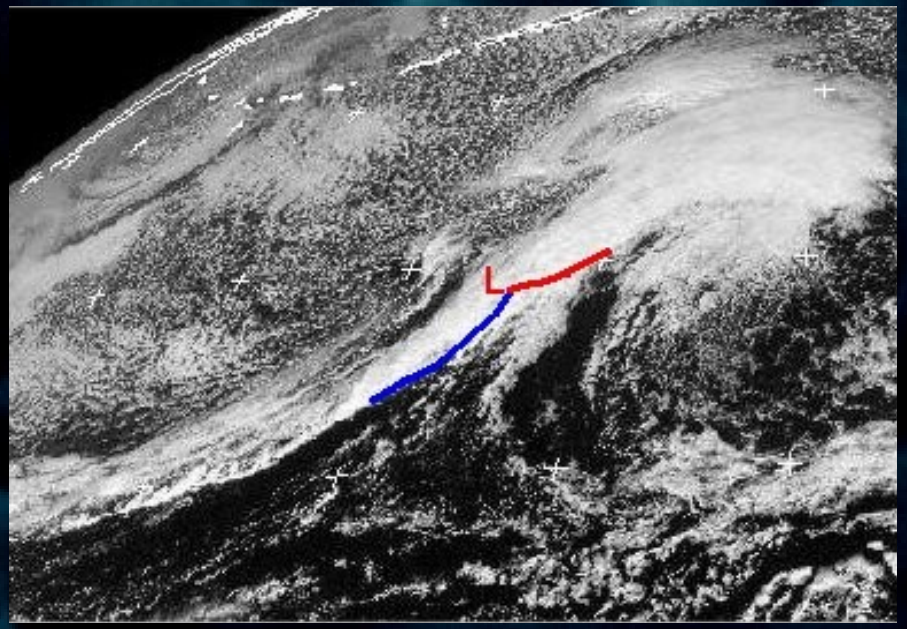

11 10 1998 /1945Z
Stationary Front Location
IR
8 km
NOAA
HTTP://WWW.GOES.NOAA.GOV

Analysis of Low Level Features

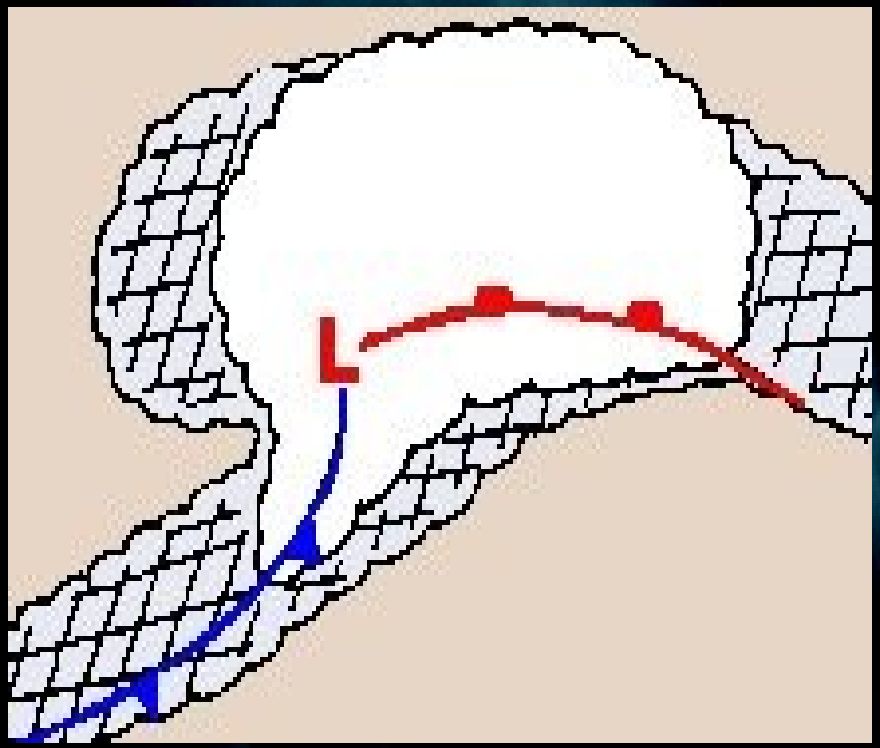
- Surface low centers
  - Cyclogenesis
    - Indications of meridional cyclogenesis
      - This classic case of cyclogenesis occurs along a baroclinic zone.
      - The frontal band widens with a slight **"S"** developing on western side.
      - On IR, cloud tops cool in the bulge.
      - On WV, the gray shade contrast increases upstream.
      - Over water, the initiating vorticity maximum can be seen as enhanced cumulus.

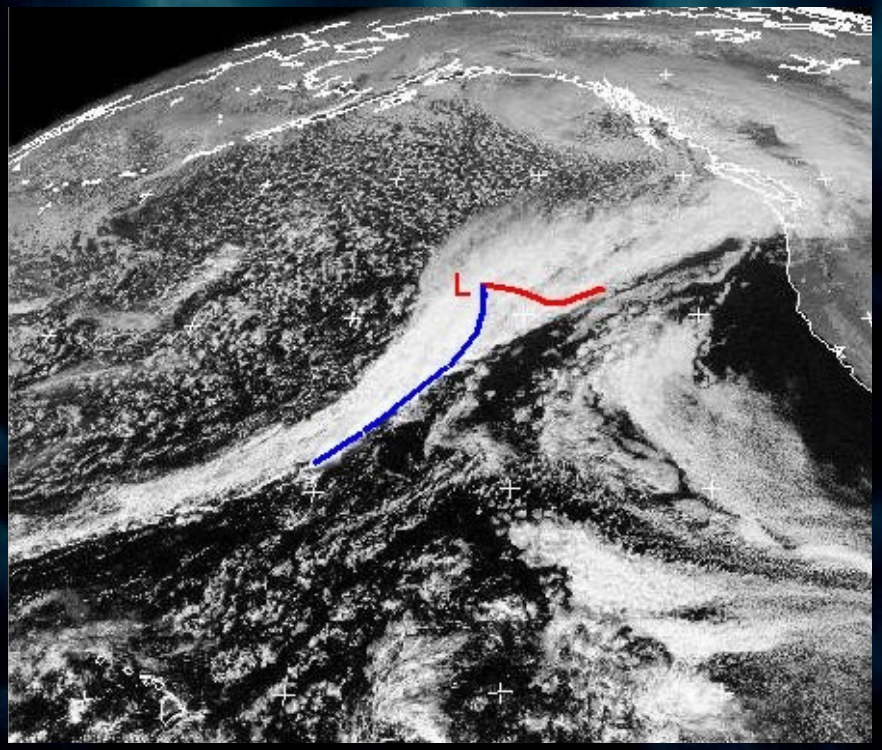
Initial Stage



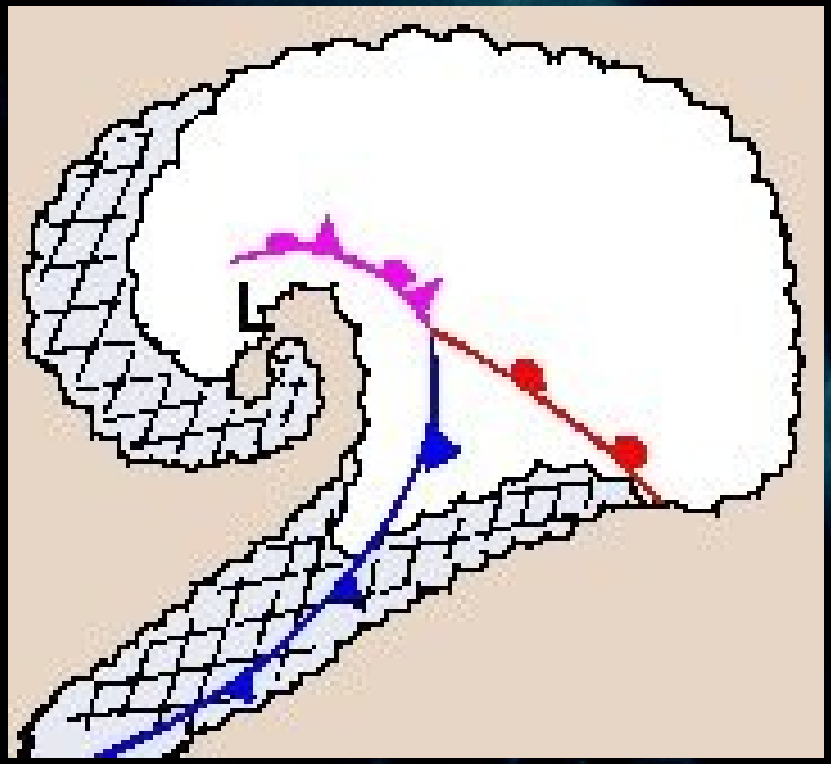


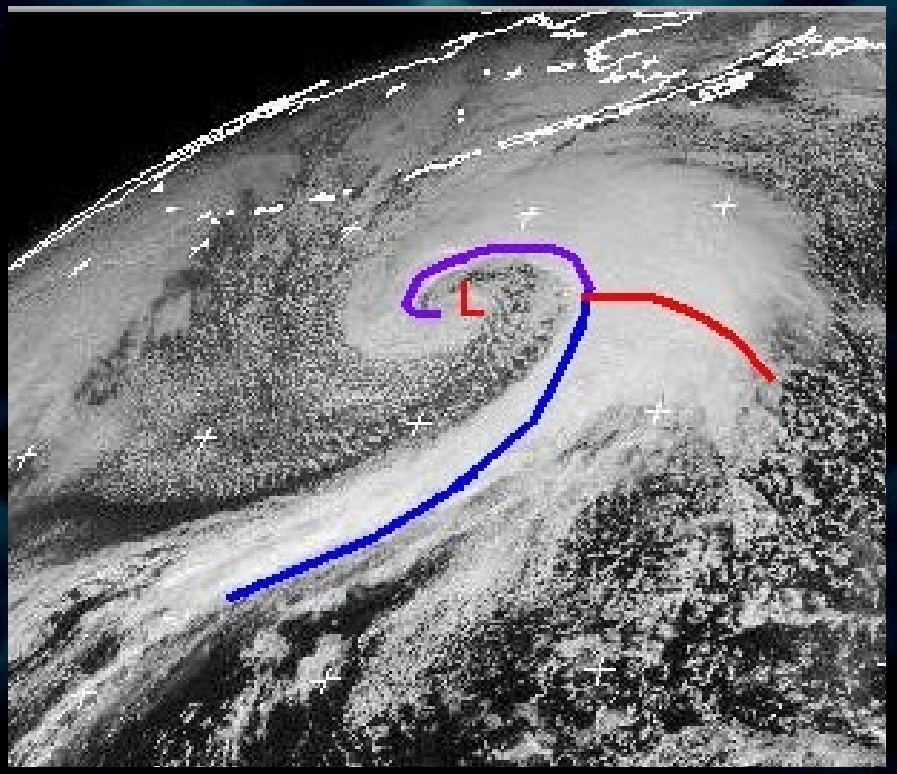
Intensification Stage



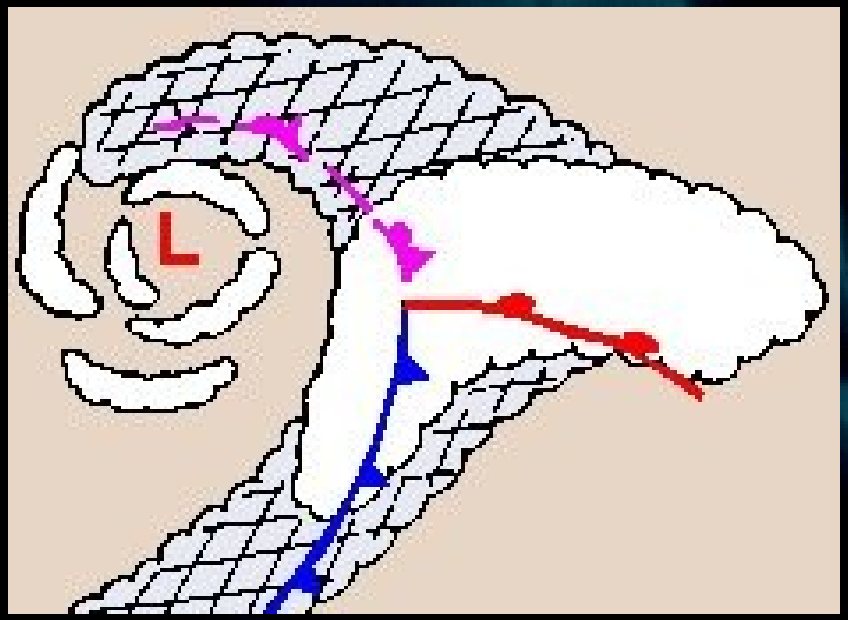


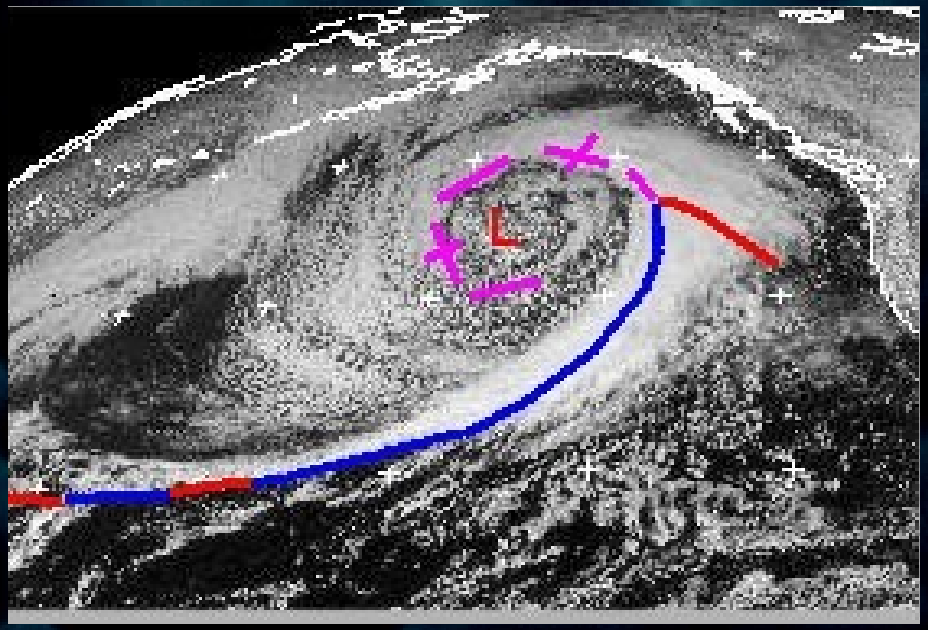
Mature Stage





Dissipation Stage





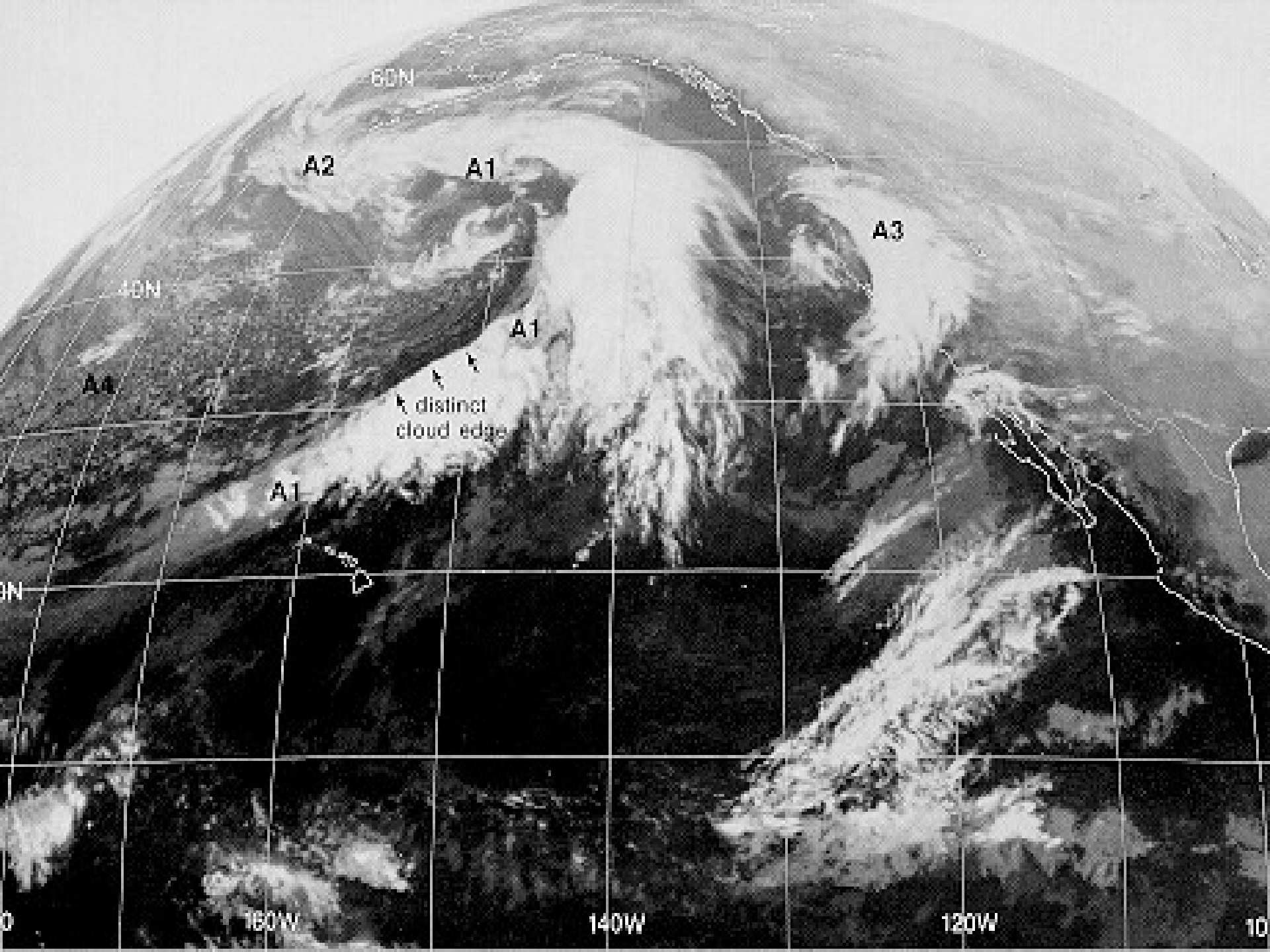
Analysis of Low Level Features

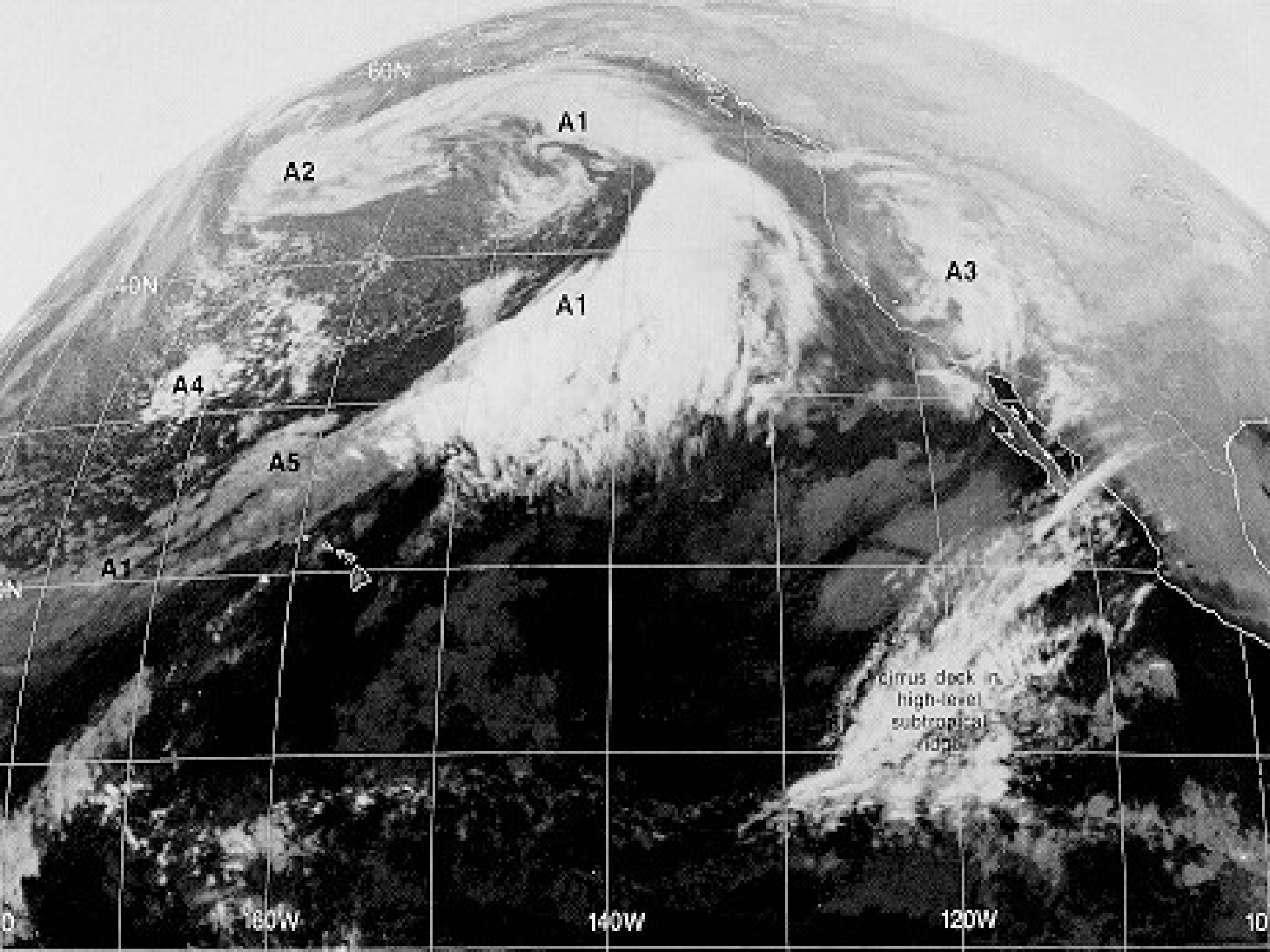
- Indications of split flow cyclogenesis
  - The jet enters southern trough region on west side of trough.
  - 500-mb closed circulation is usually seen early; Then builds up and down.

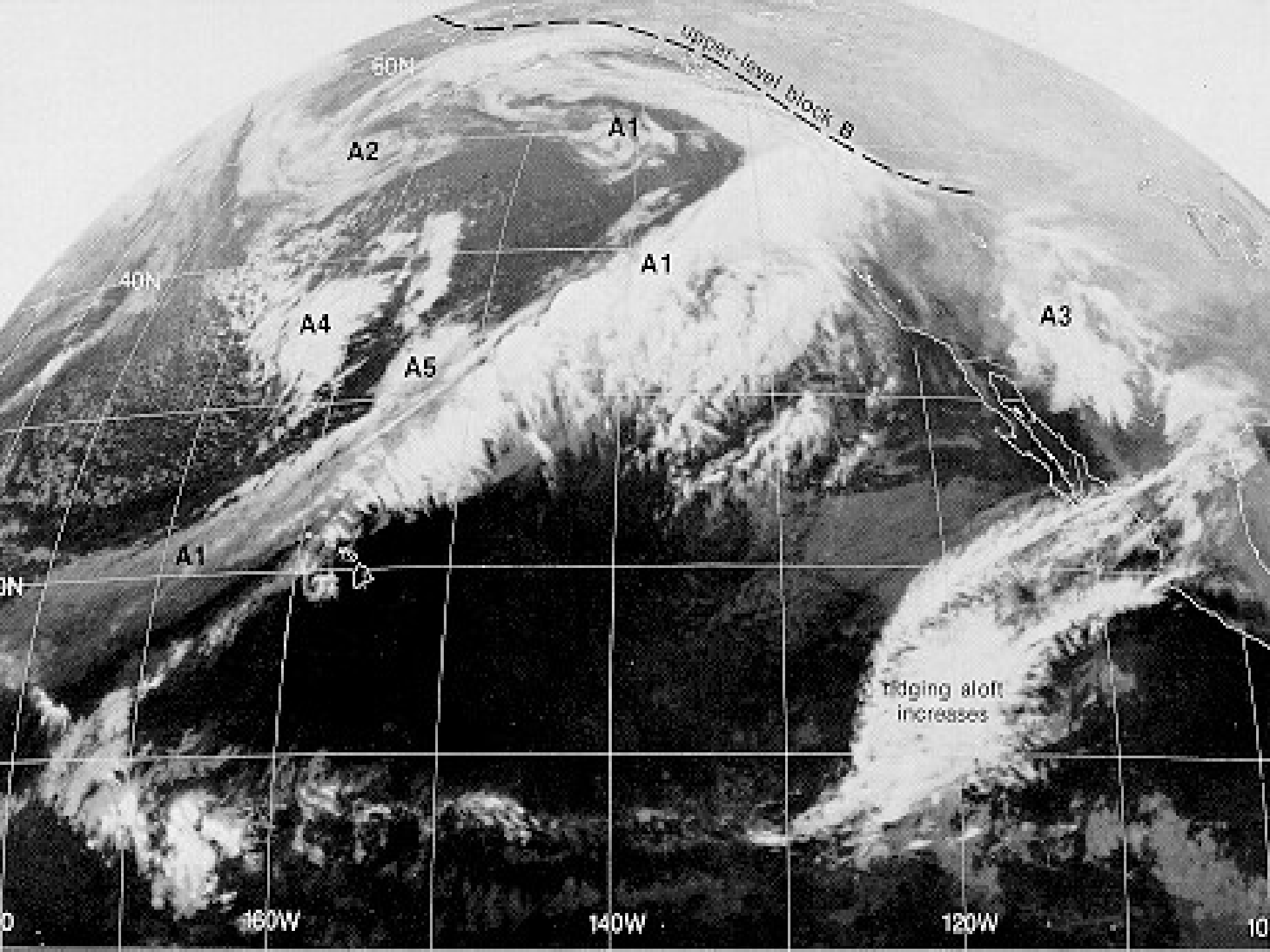
Analysis of Low Level Features

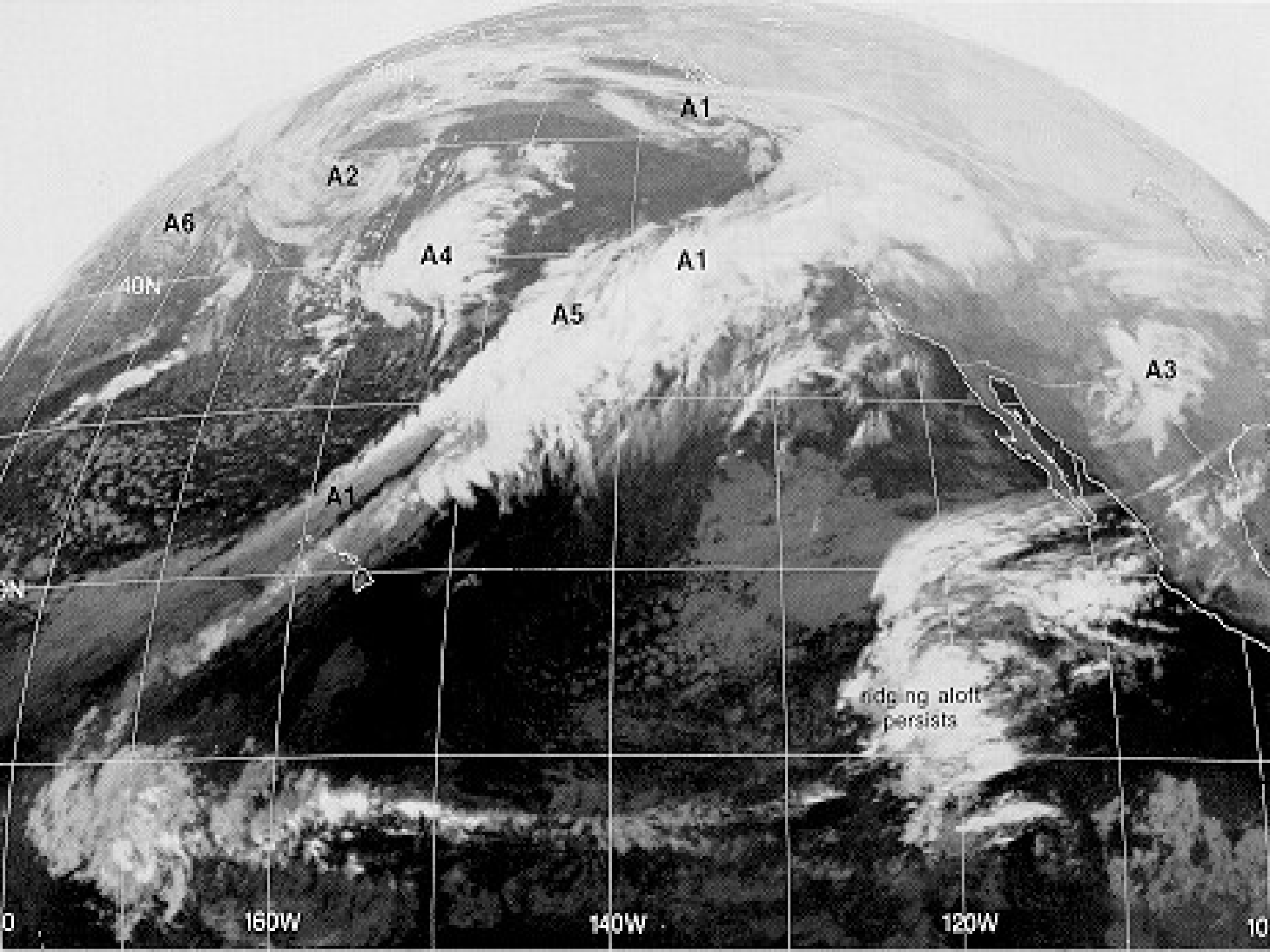
- The location of the surface low depends on the stage of development
.
  - Type A system (meridional cyclogenesis).
    - Initial stage
      - » Look for the **“S” shape** changing over time.
      - » The low is located halfway into cloud band from the inflection point.
    - Intensification stage
      - » The dry slot starts to form.
      - » The low translates along back edge of comma cloud.

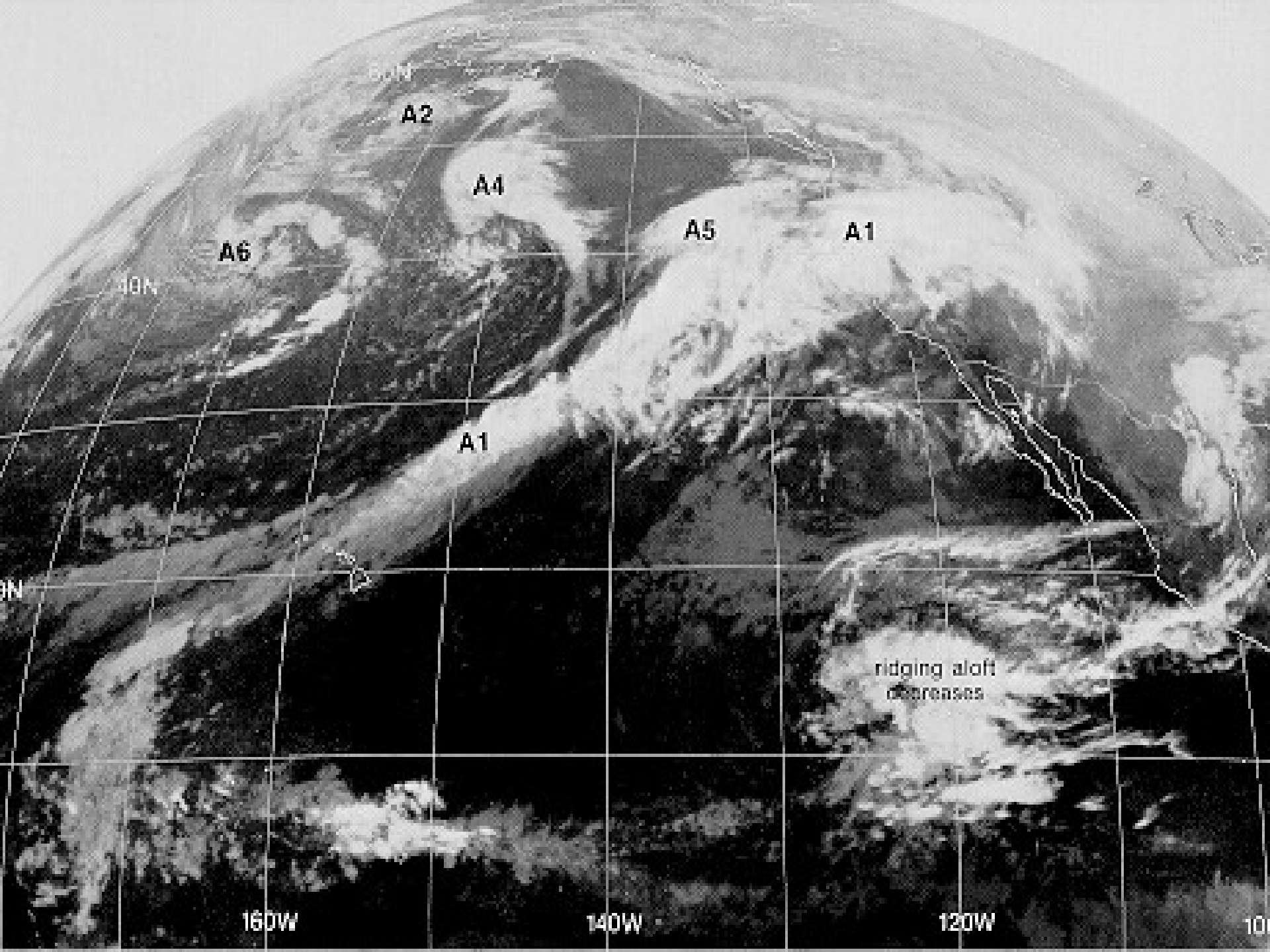
Cyclogenesis – Location of Surface Low

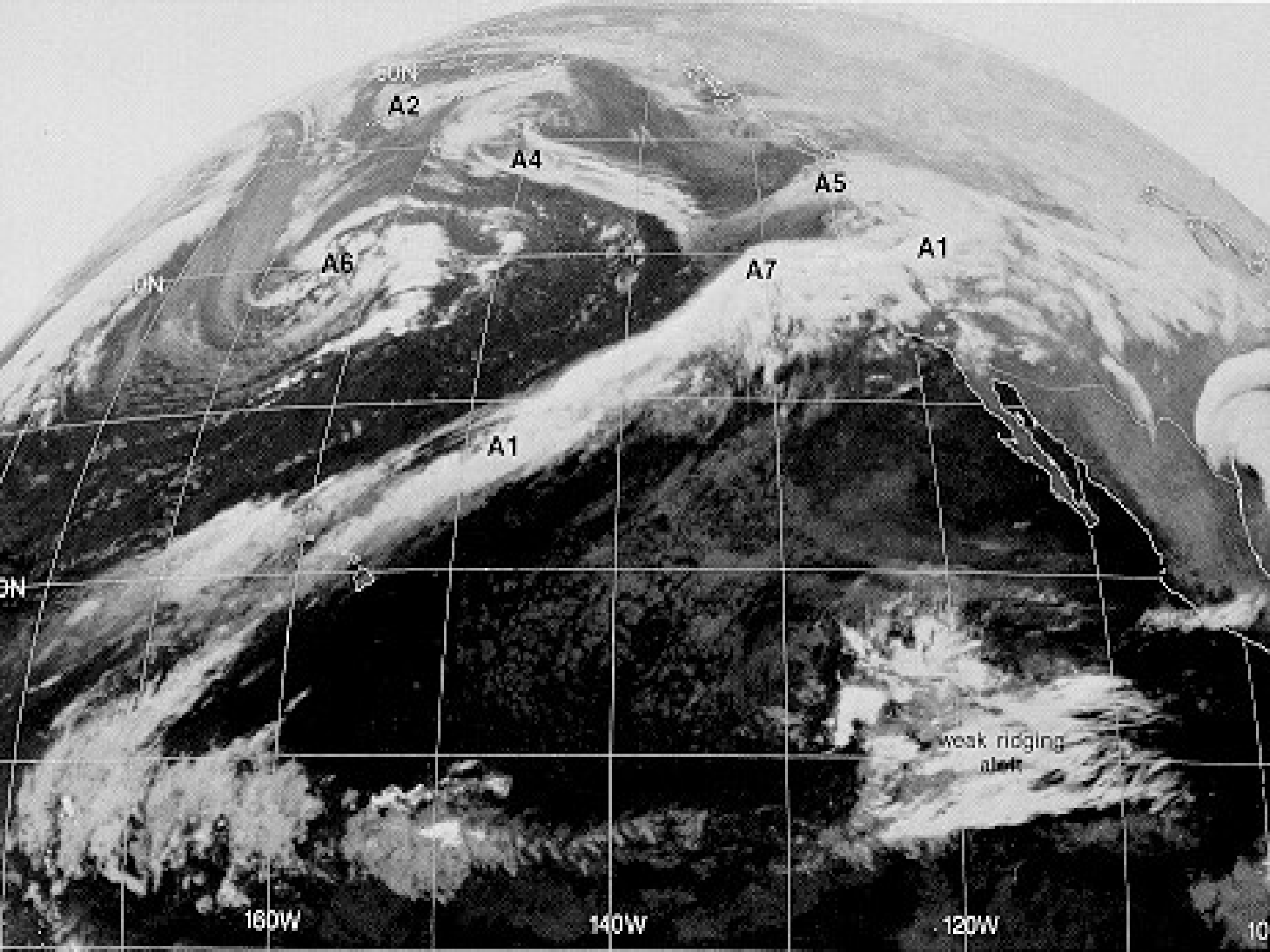

60N
40N
A2
A1
A3
A1
A4
distinct
cloud edge
A1
160W
140W
120W

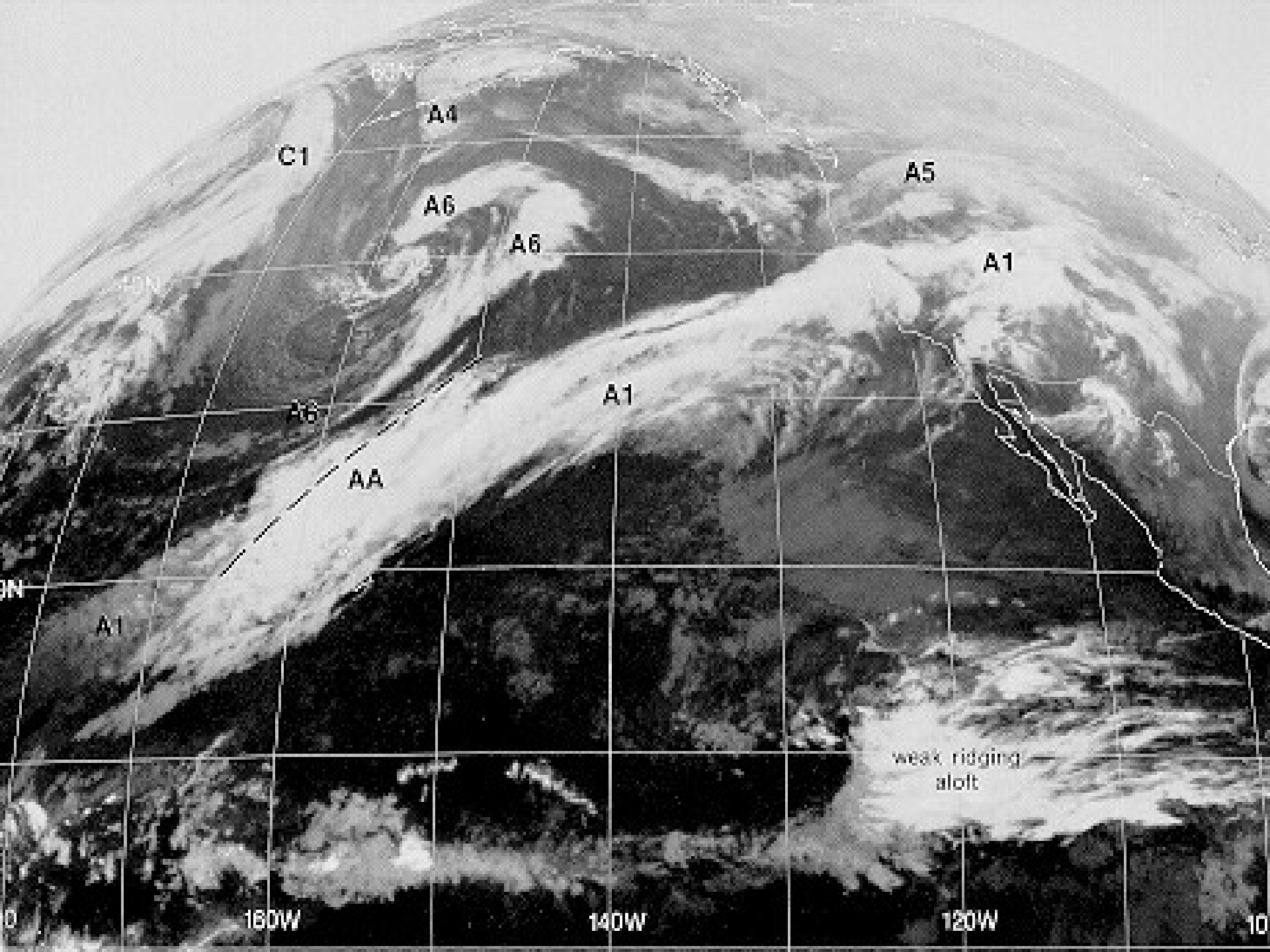

60N
A1
A2
A3
A1
A4
A5
A1
cirrus deck in
high-level
subtropical
ridge
160W
140W
120W

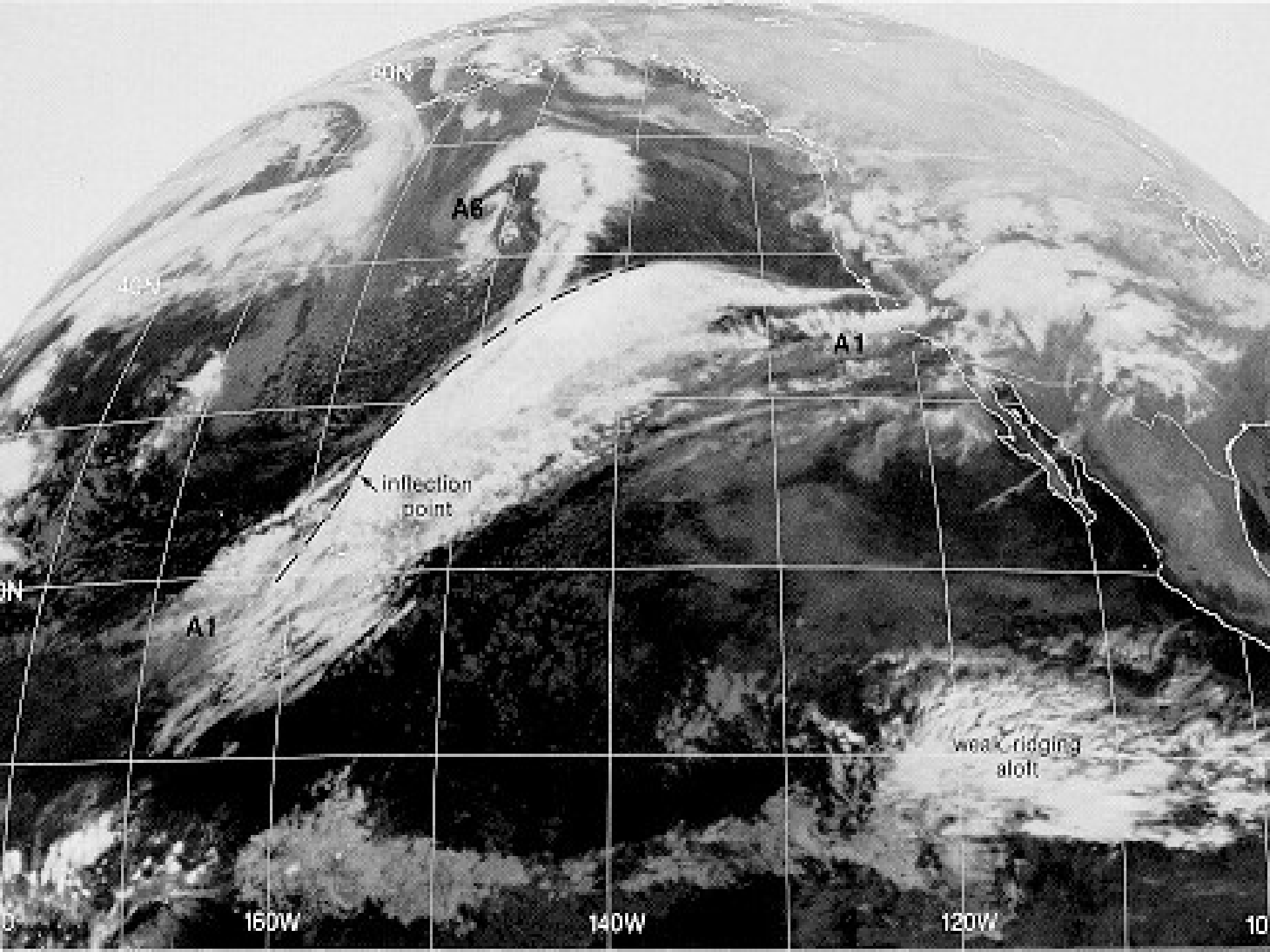

upper-level block
60N
40N
A1
A2
A1
A4
A5
A3
A1
Tilging aloft
increases
160W
140W
120W

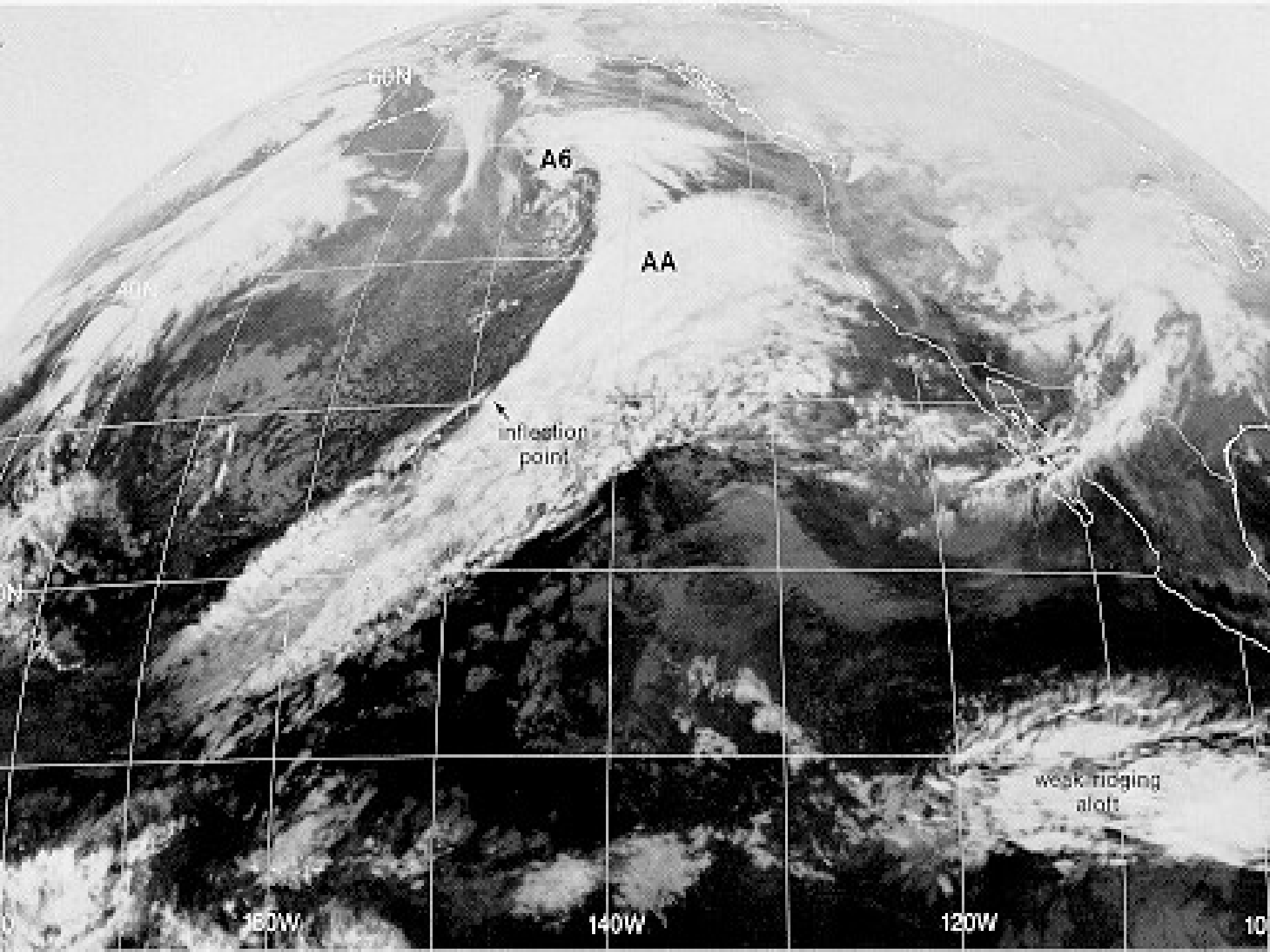

A1
A2
A6
A4
A1
40N
A5
A3
A1
ridging aloft
persists
160W
140W
120W

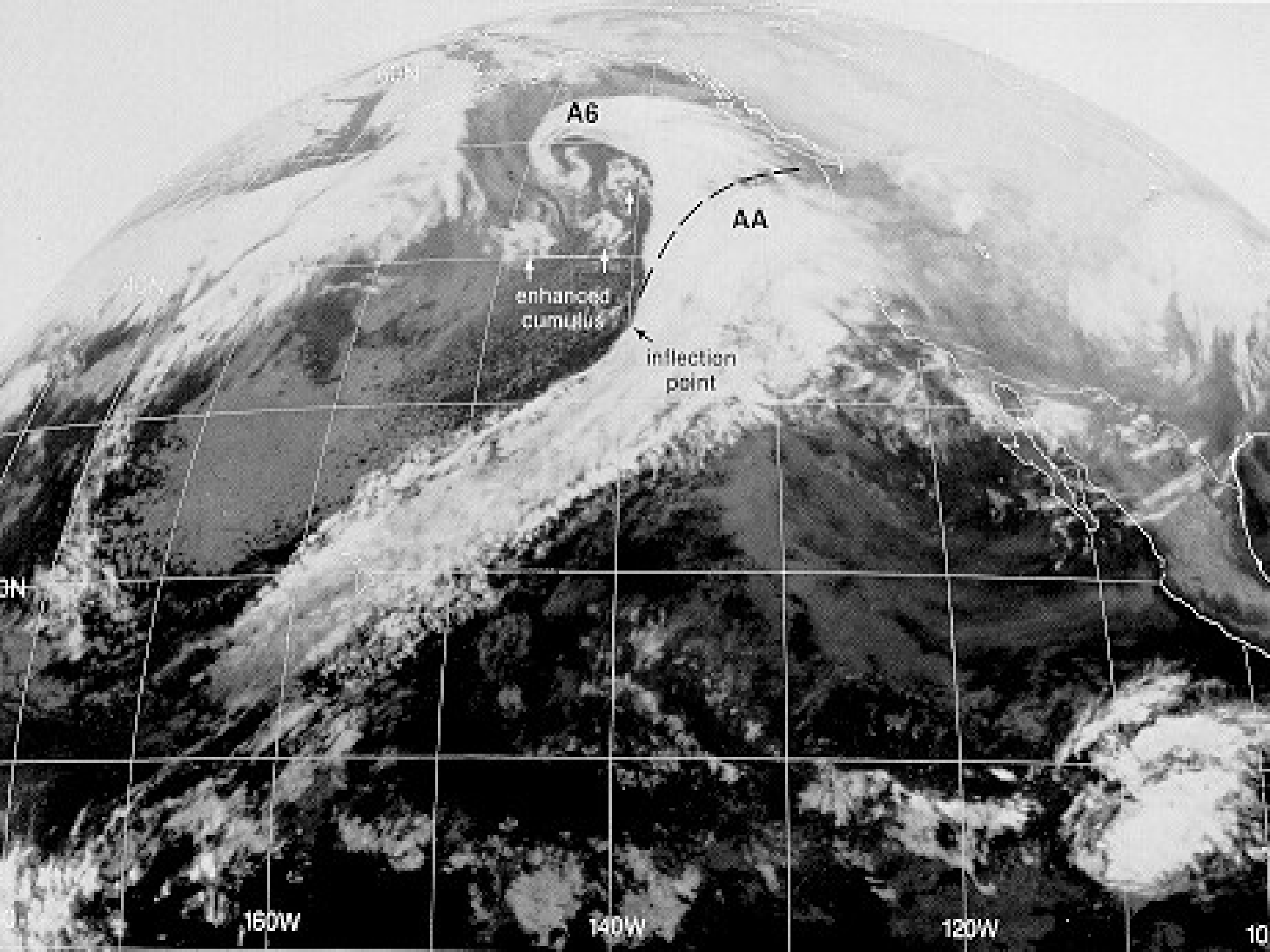

A2
A4
A5
A1
A6
A1
ridging aloft
decreases
160W
140W
120W

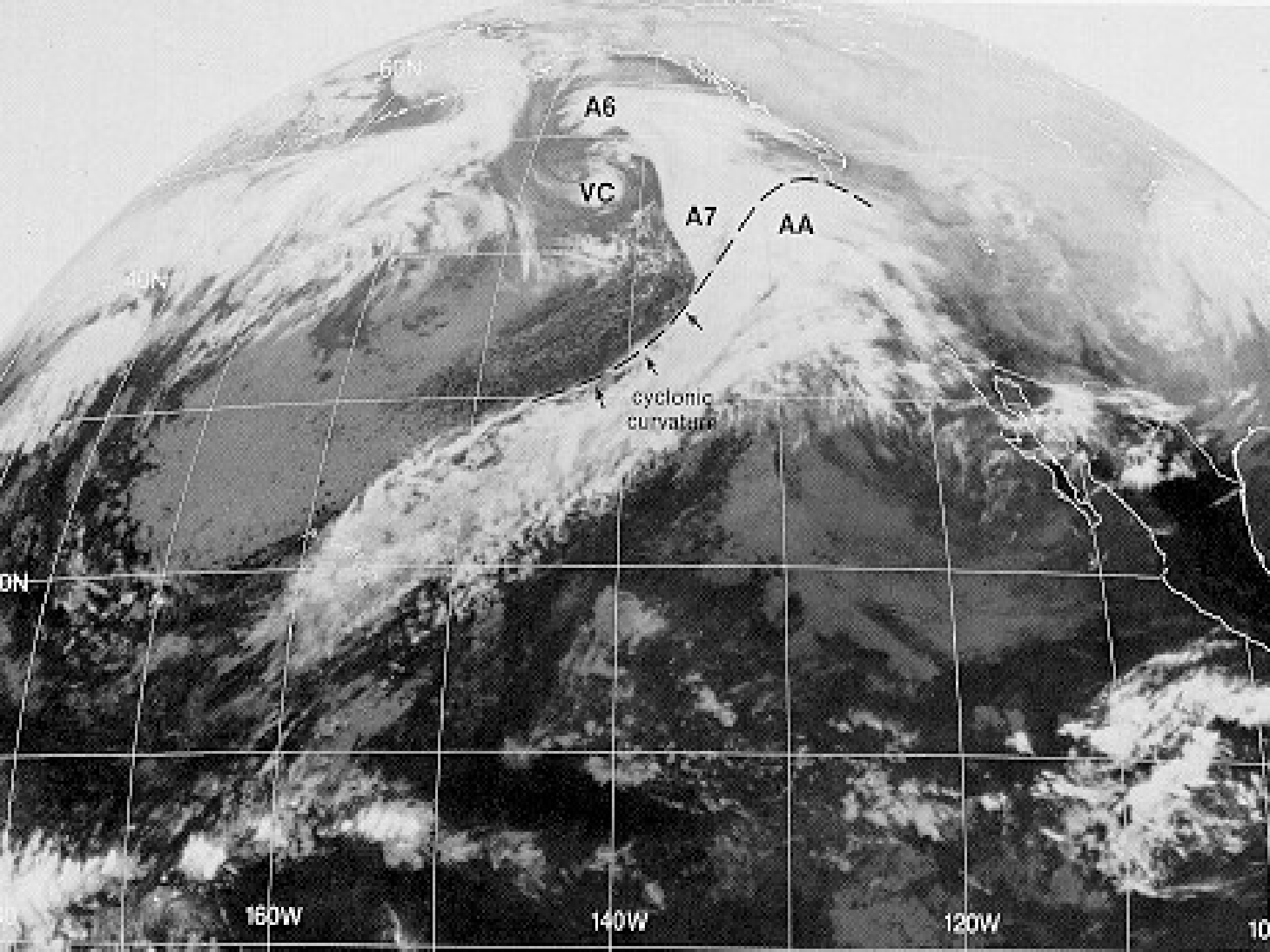

80N
A2
A4
A5
A1
A6
A7
70N
A1
60N
weak ridging
160W
140W
120W

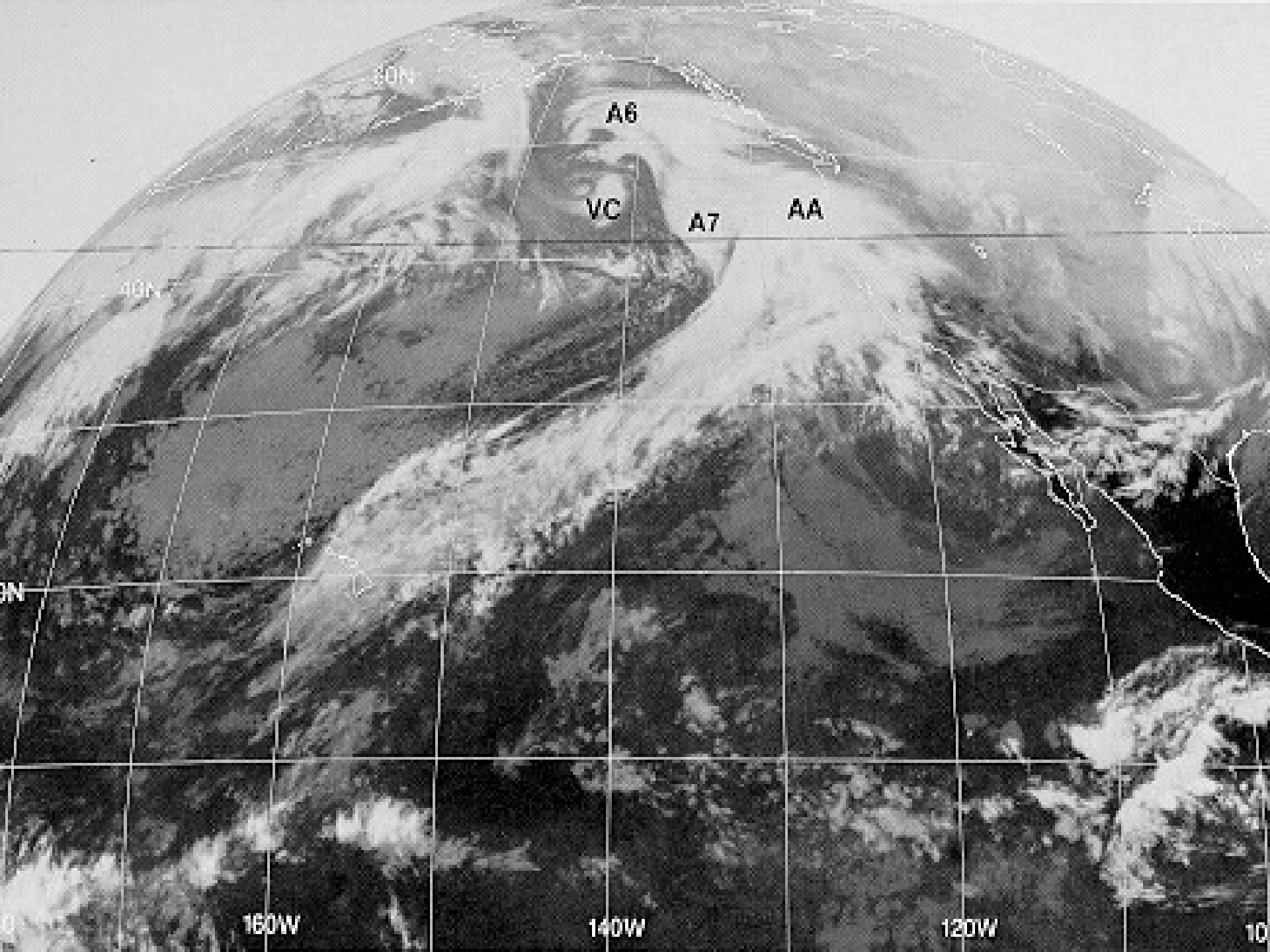

A4
C1
A5
A6
A6
A1
A6
A1
AA
A1
weak ridging
aloft
160W
140W
120W

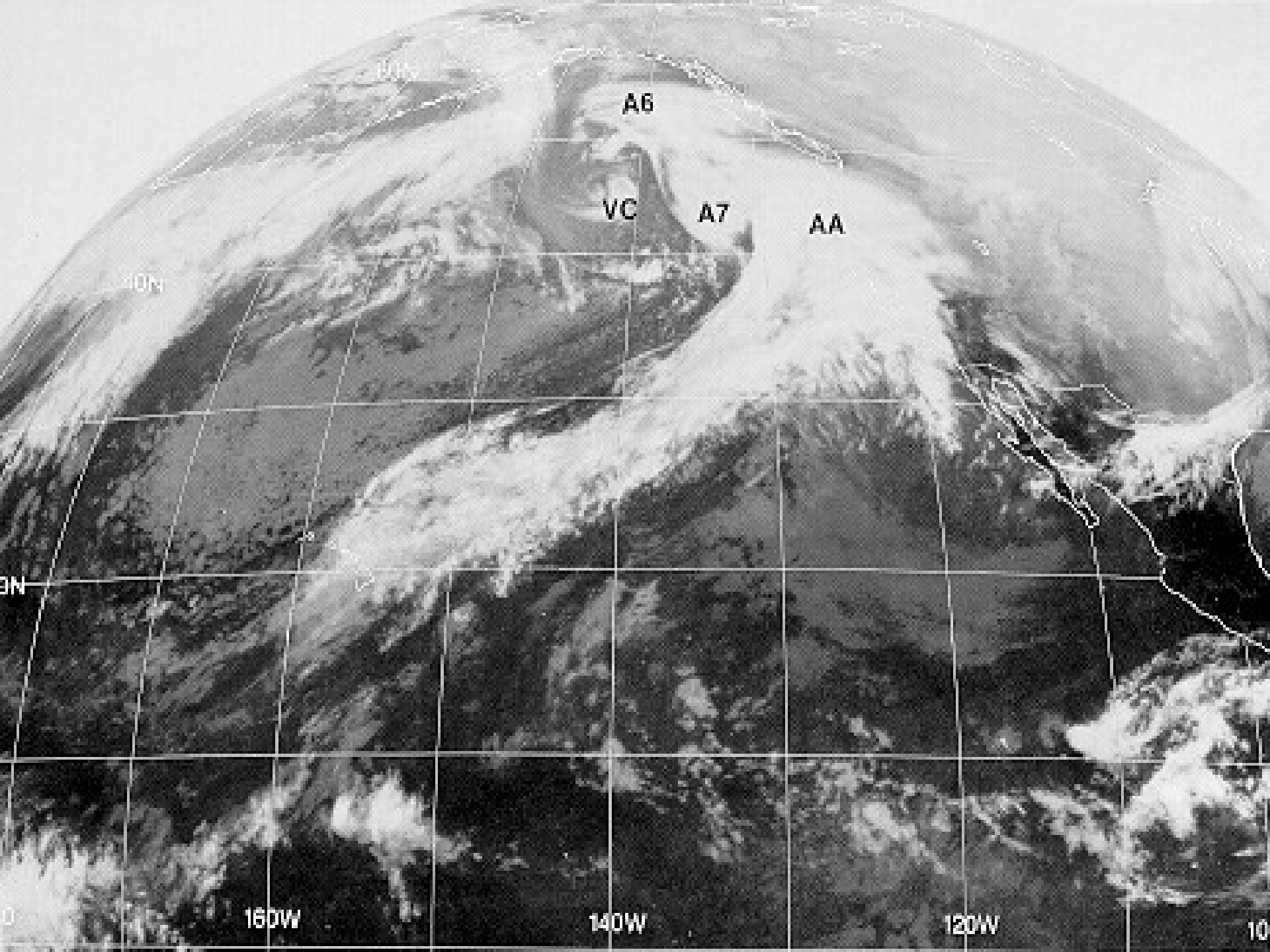

A6
A1
A1
inflection point
weak ridging aloft
160W
140W
120W

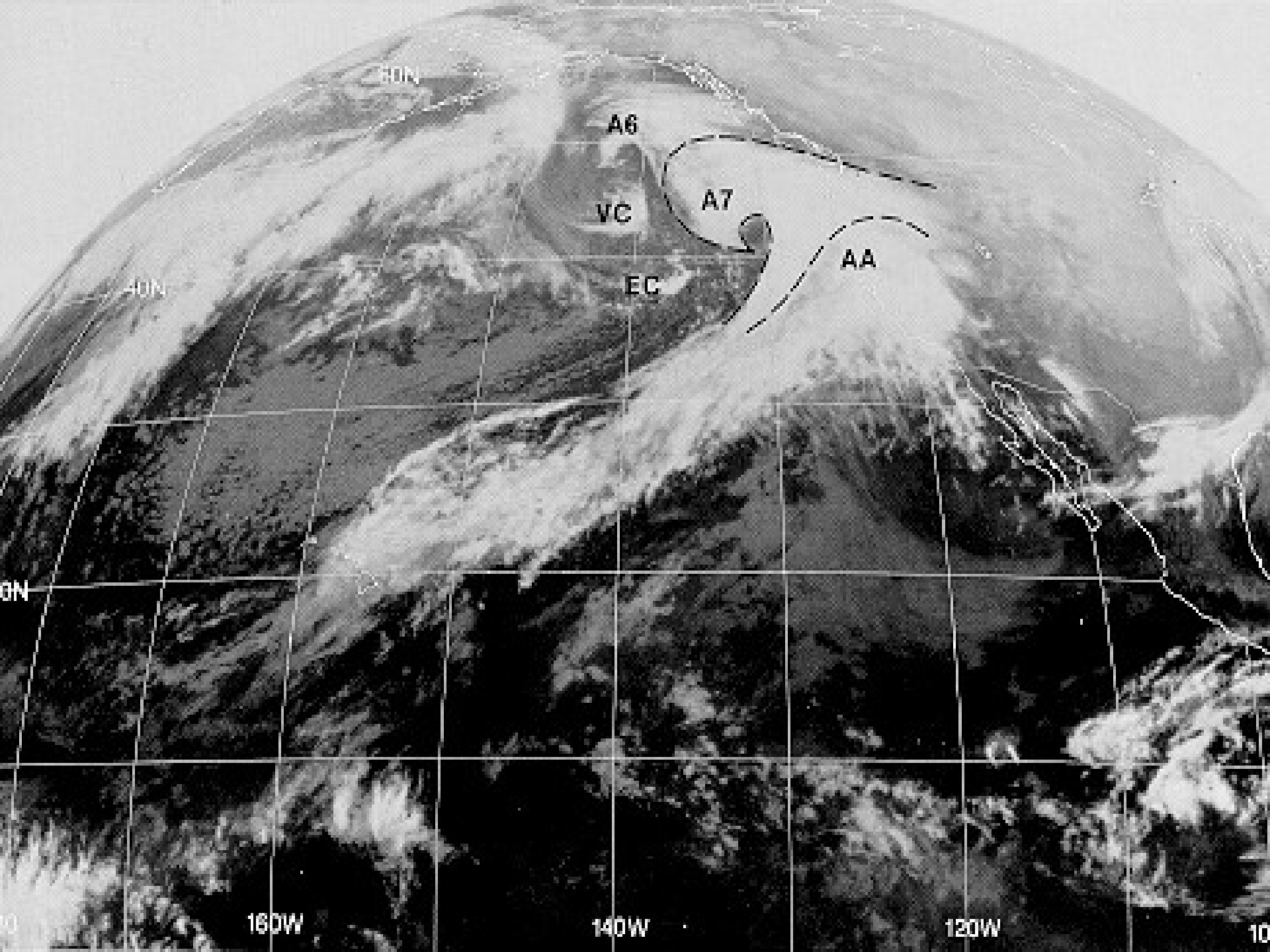

A6
AA
inflection point
weak ridging aloft
140W
120W

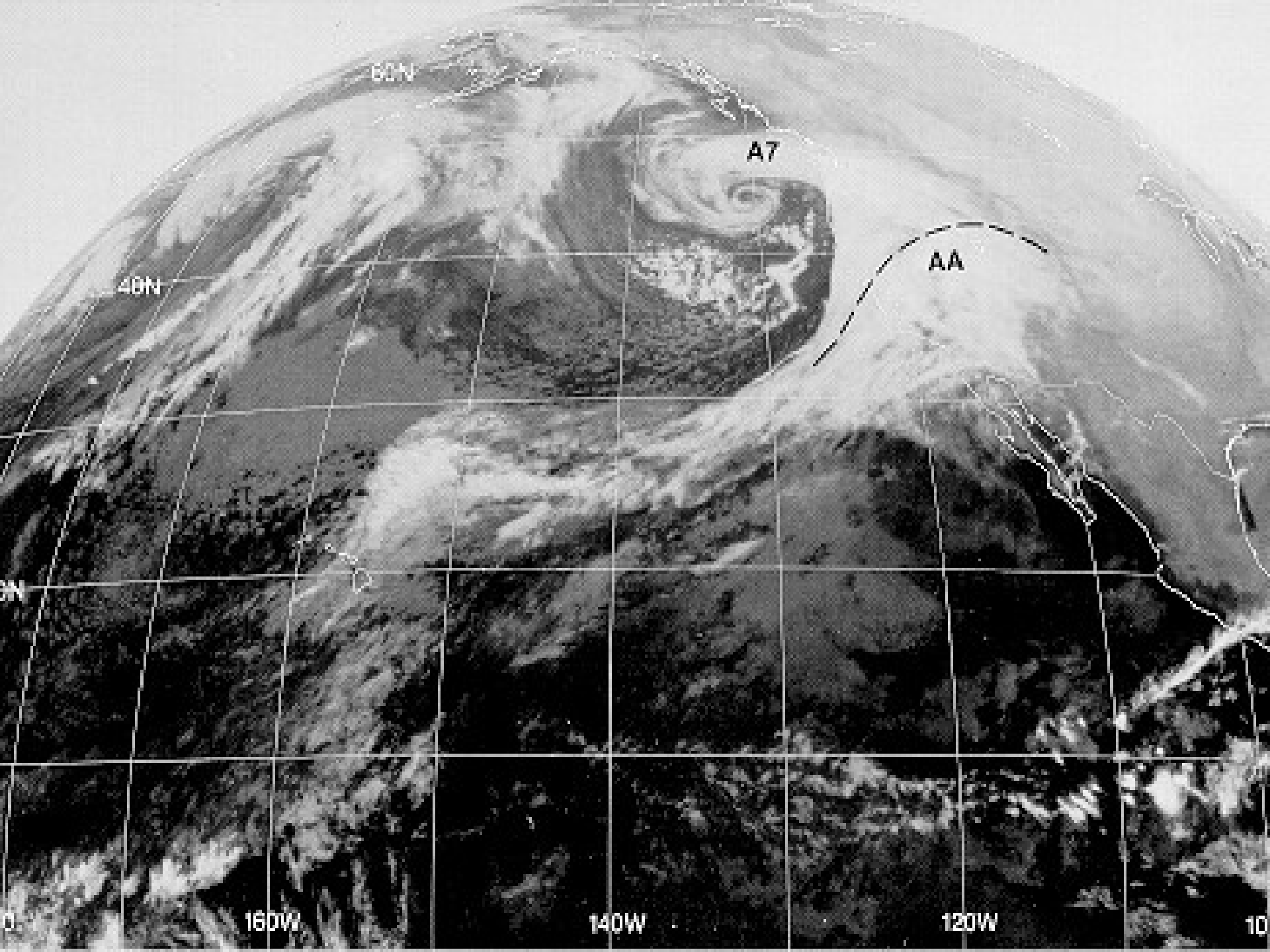

A6
AA
enhanced
cumulus
inflection
point
160W
140W
120W


A6
VC
A7
AA
cyclonic
curvature
160W
140W
120W


A6
VC
A7
AA
160W
140W
120W


A6
VC
A7
AA
160W
140W
120W


60N
40N
0N
A6
VC
A7
AA
EC
160W
140W
120W


60N
A7
AA
40N
160W
140W
120W

Analysis of Low Level Features

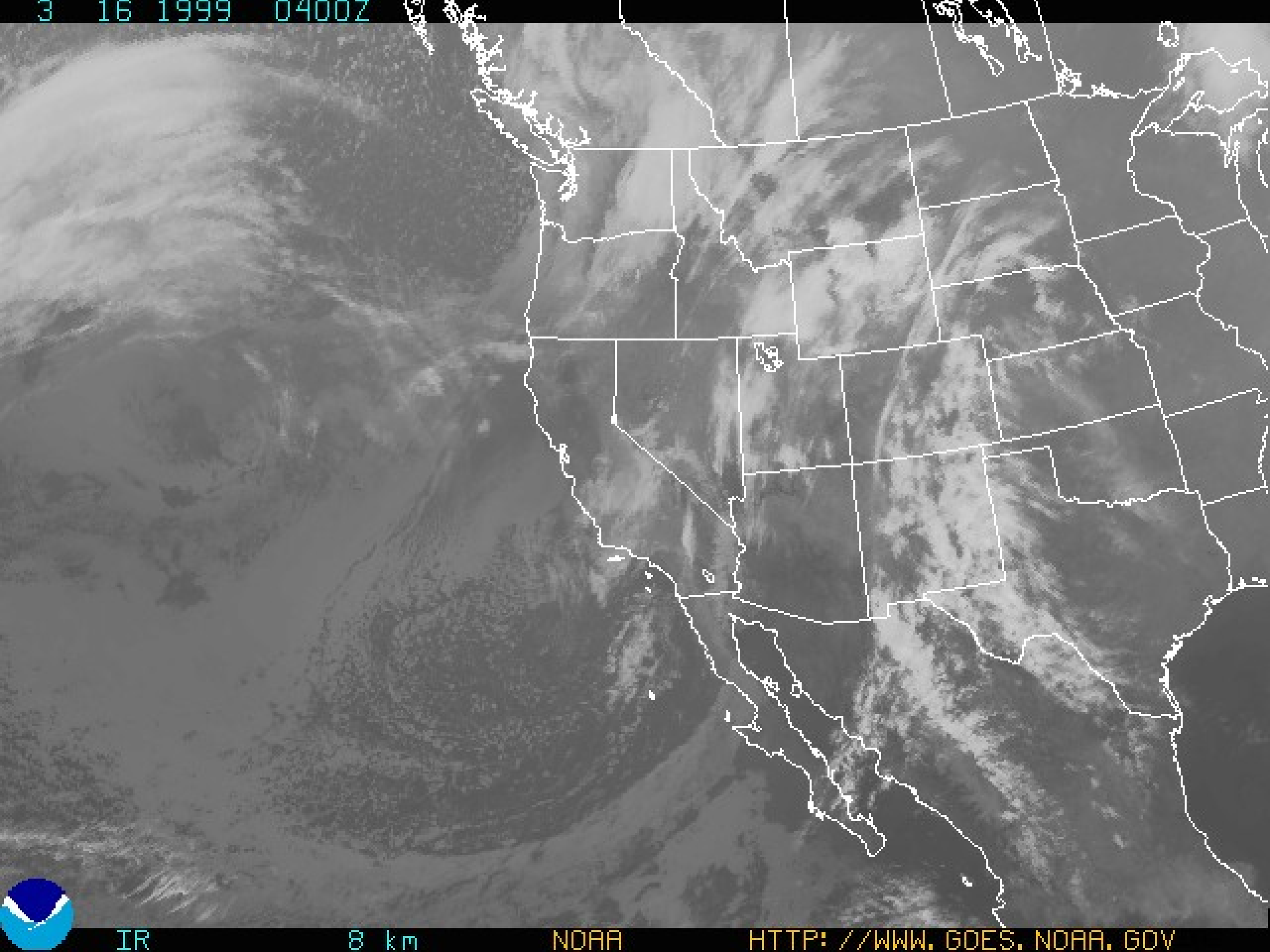
- Mature stage
  - The surface low is starting to become more vertically stacked with upper low.
  - It is located on upstream edge of the vorticity comma cloud, ESE of the cusp.
- Dissipation stage (decaying wave)
  - The surface low fills and is hard to identify.
  - Fragmented clouds are used to locate.

Analysis of Low Level Features

- Type B system (split flow cyclogenesis).
  - 1 the surface low is hard to define due to the appearance and coverage of the baroclinic zone cirrus.
  - 2 the surface low can generally be found by interpolating the intersection of the warm and cold fronts, with the low under the baroclinic zone cirrus.

Cyclogenesis Animation

Pacific Northwest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IR
8 km
NOAA
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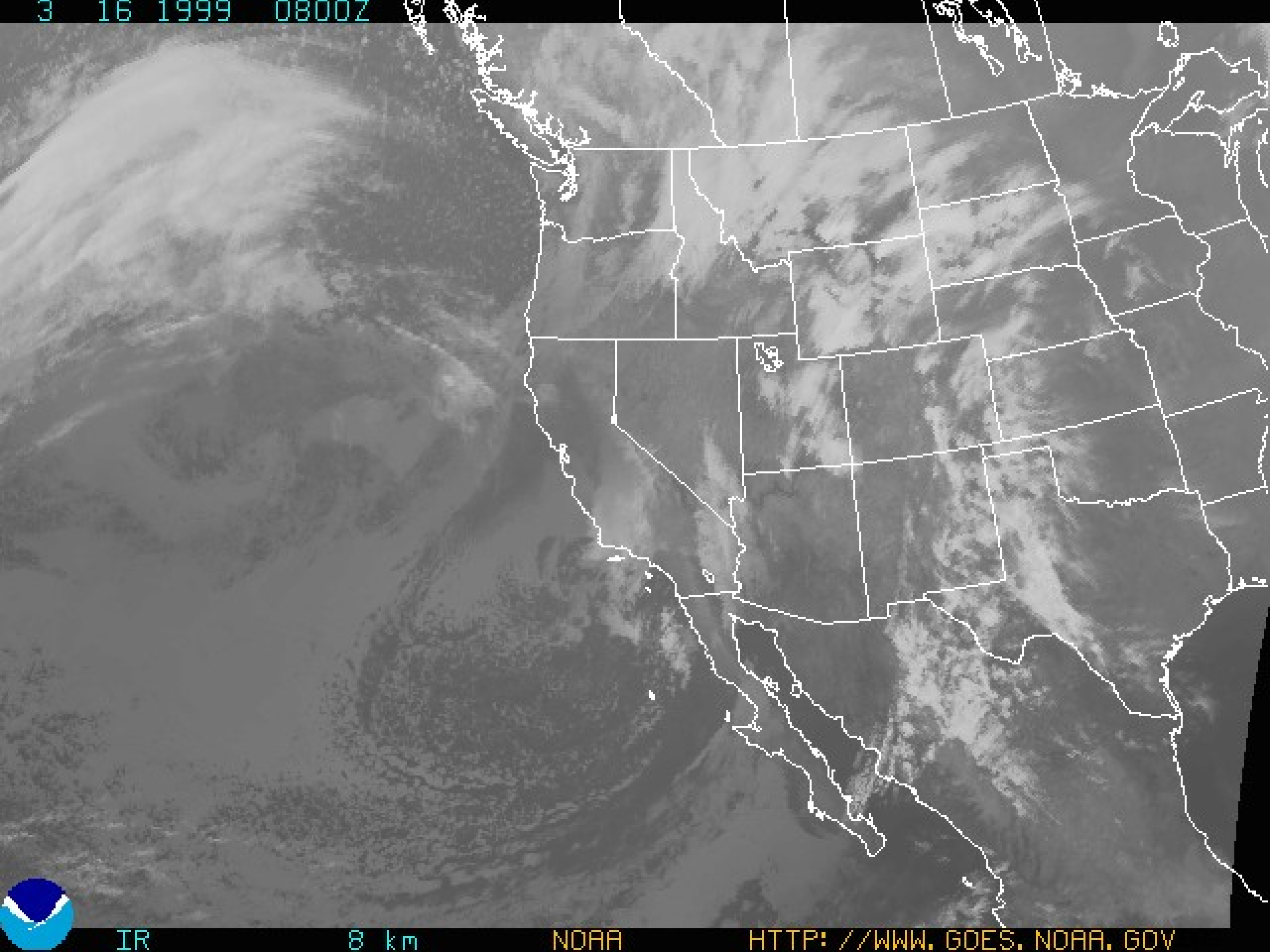
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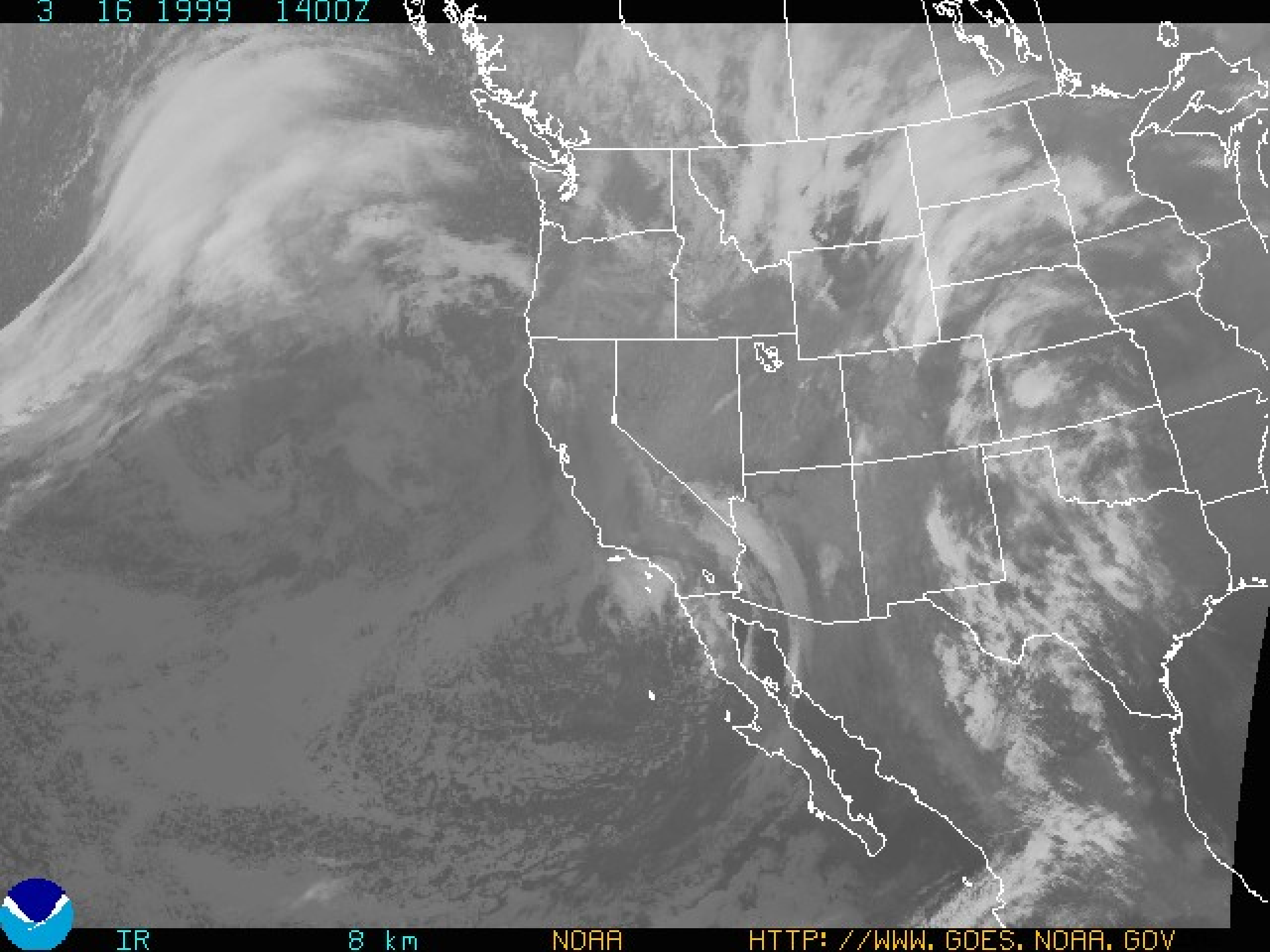
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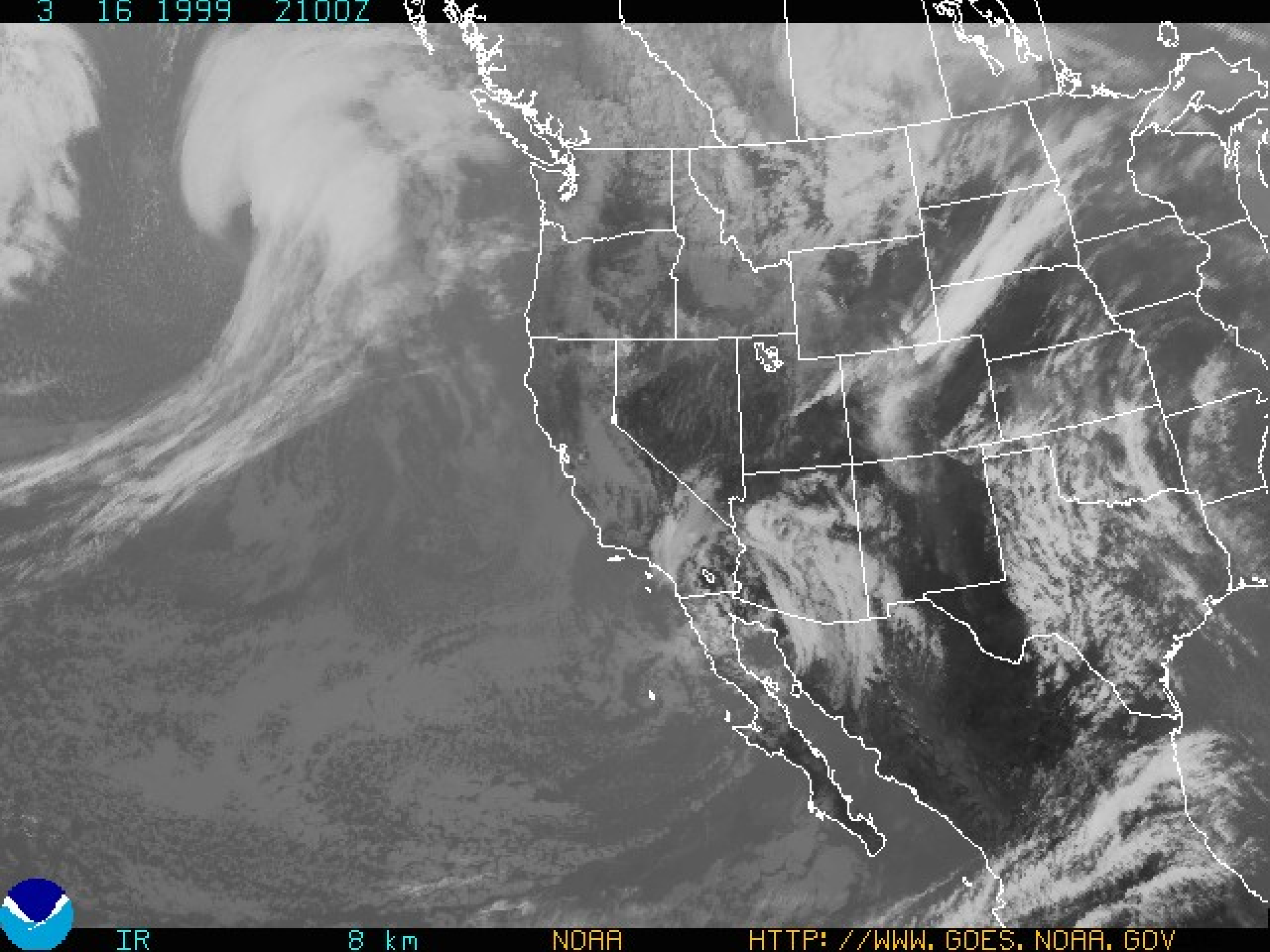
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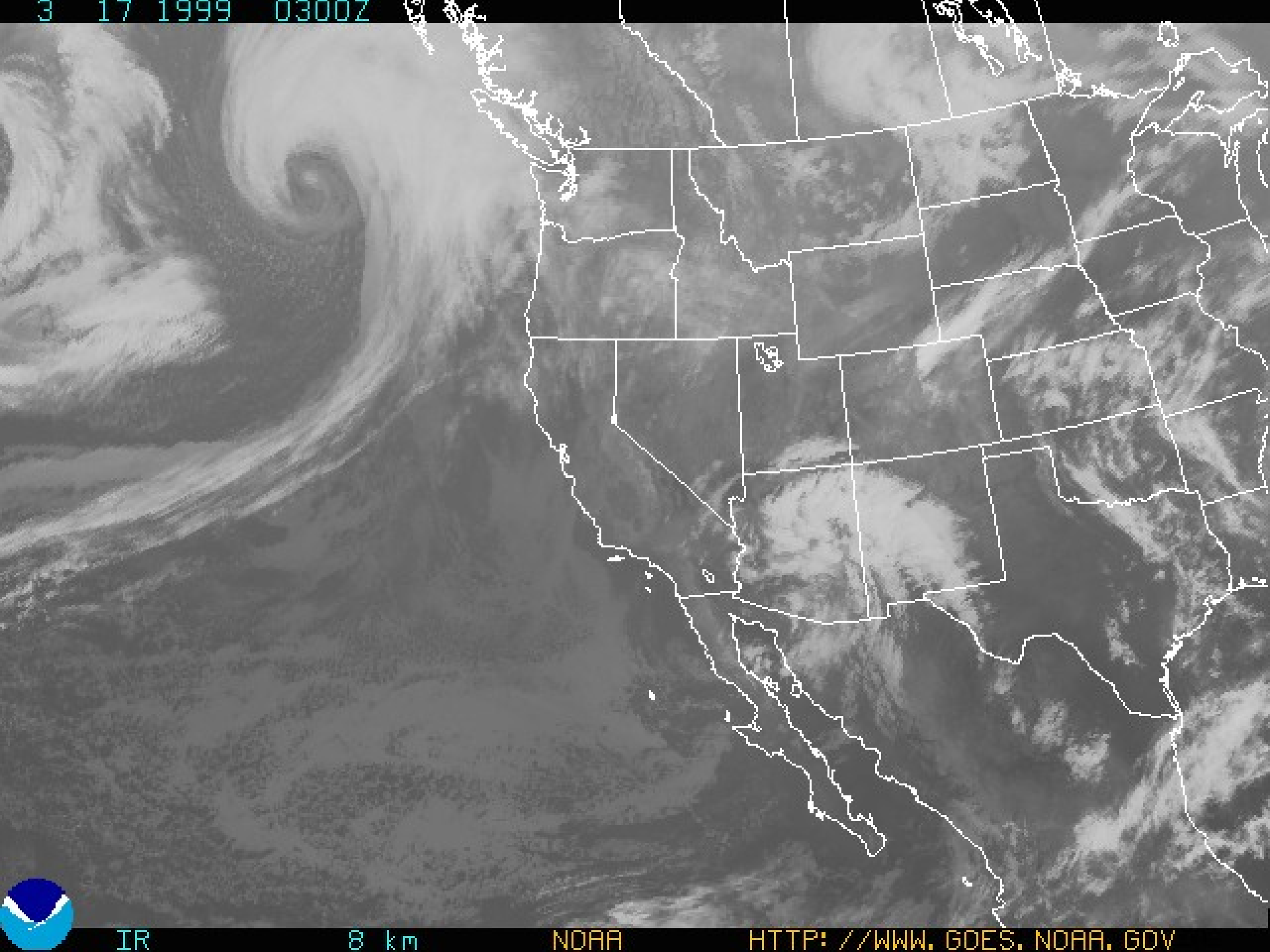
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IR
8 km
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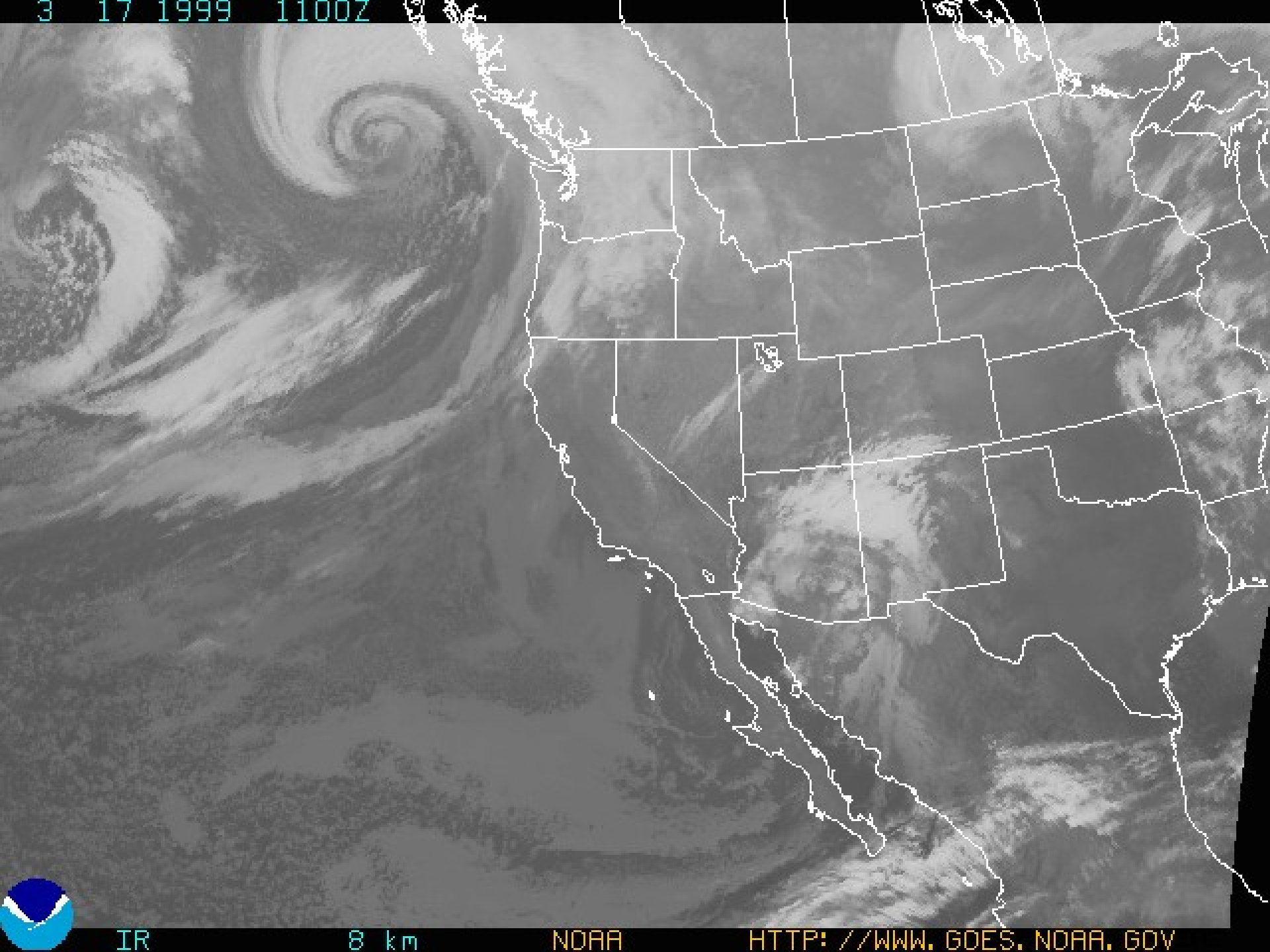
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IR
8 km
NOAA
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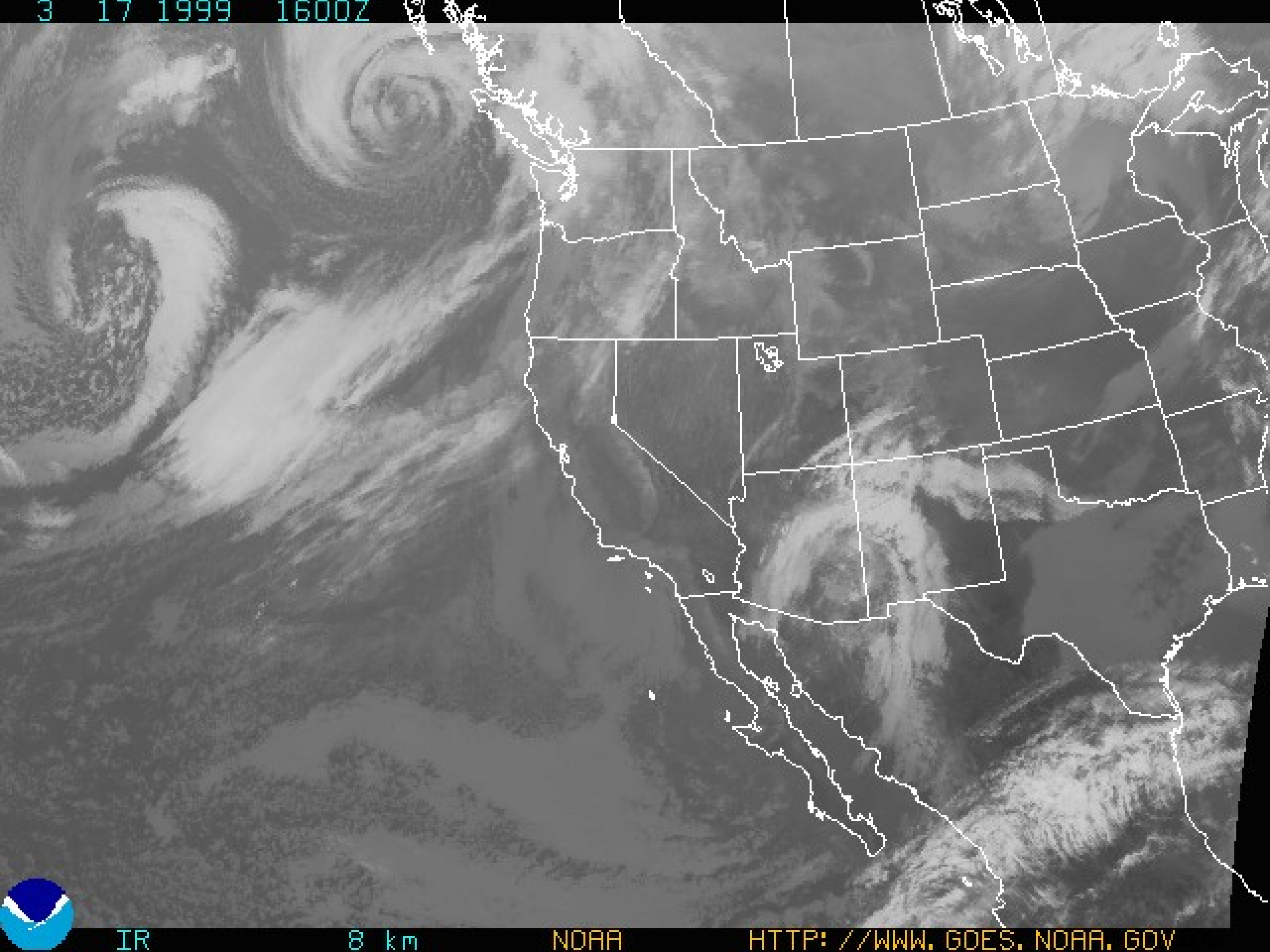
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IR
8 km
NOAA
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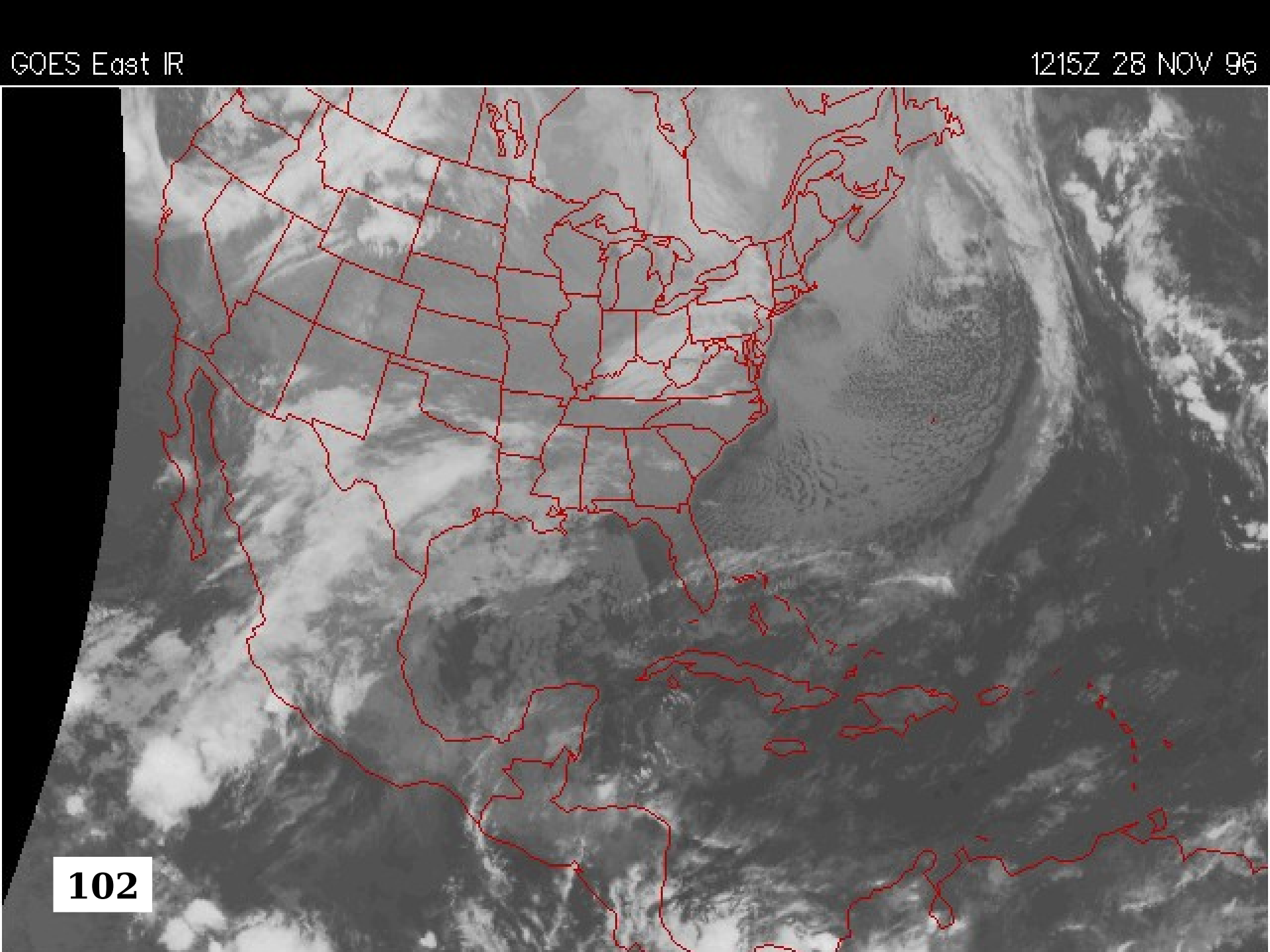
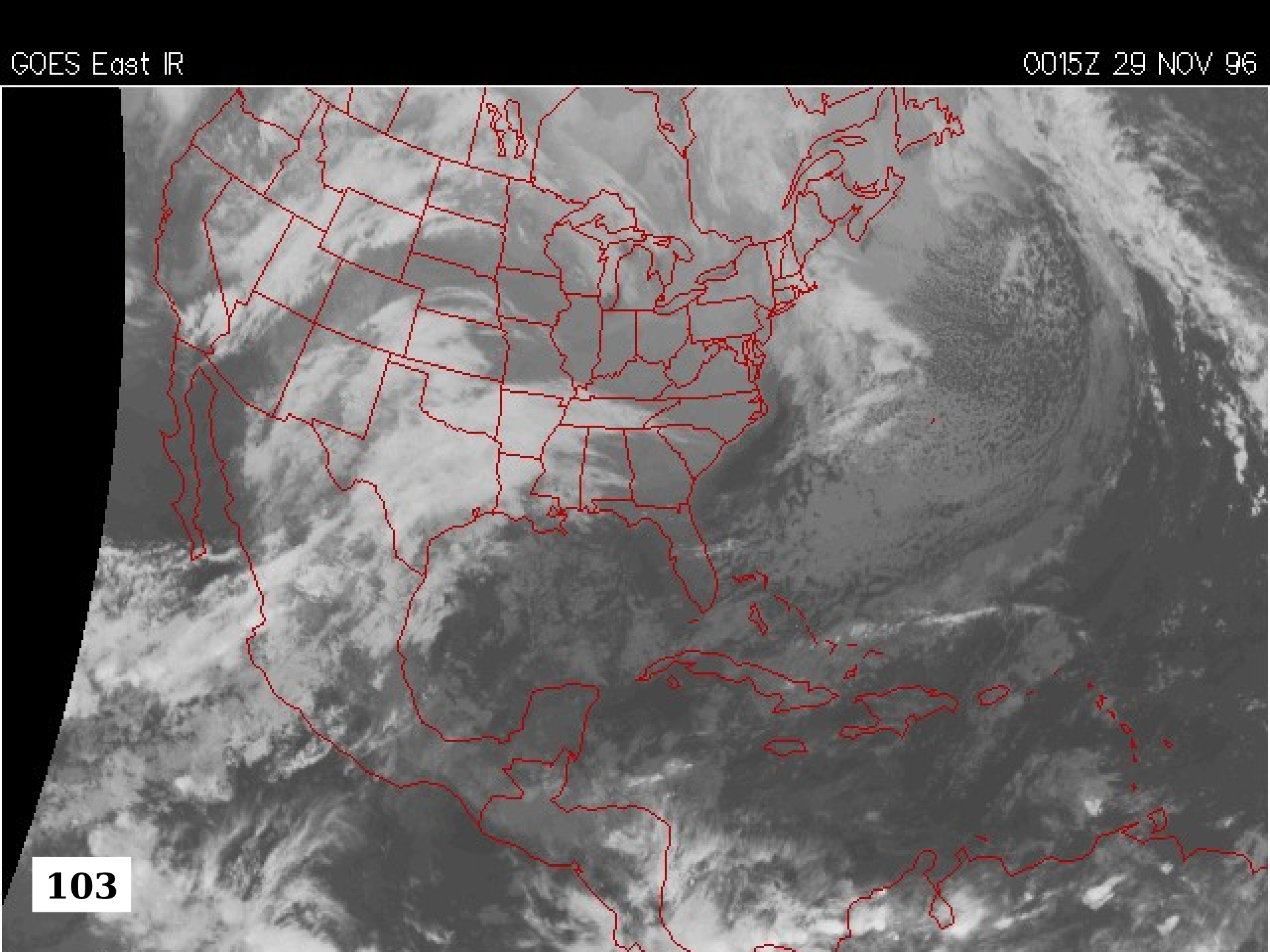
Cyclogenesis Animation

The Midwest


GOES East IR
1215Z 28 NOV 96
102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0015Z 29 NOV 96
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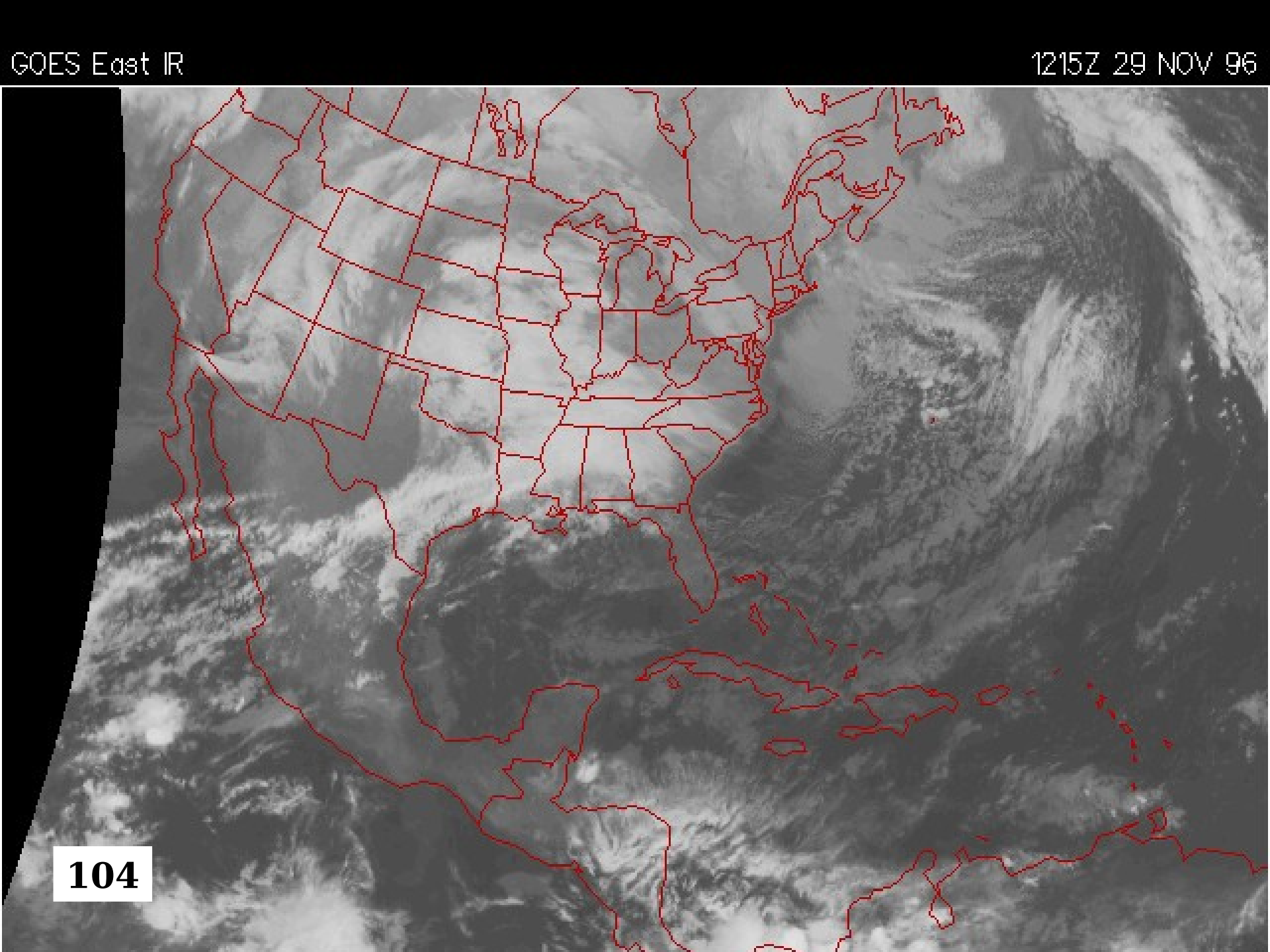
GOES East IR
1215Z 29 NOV 96
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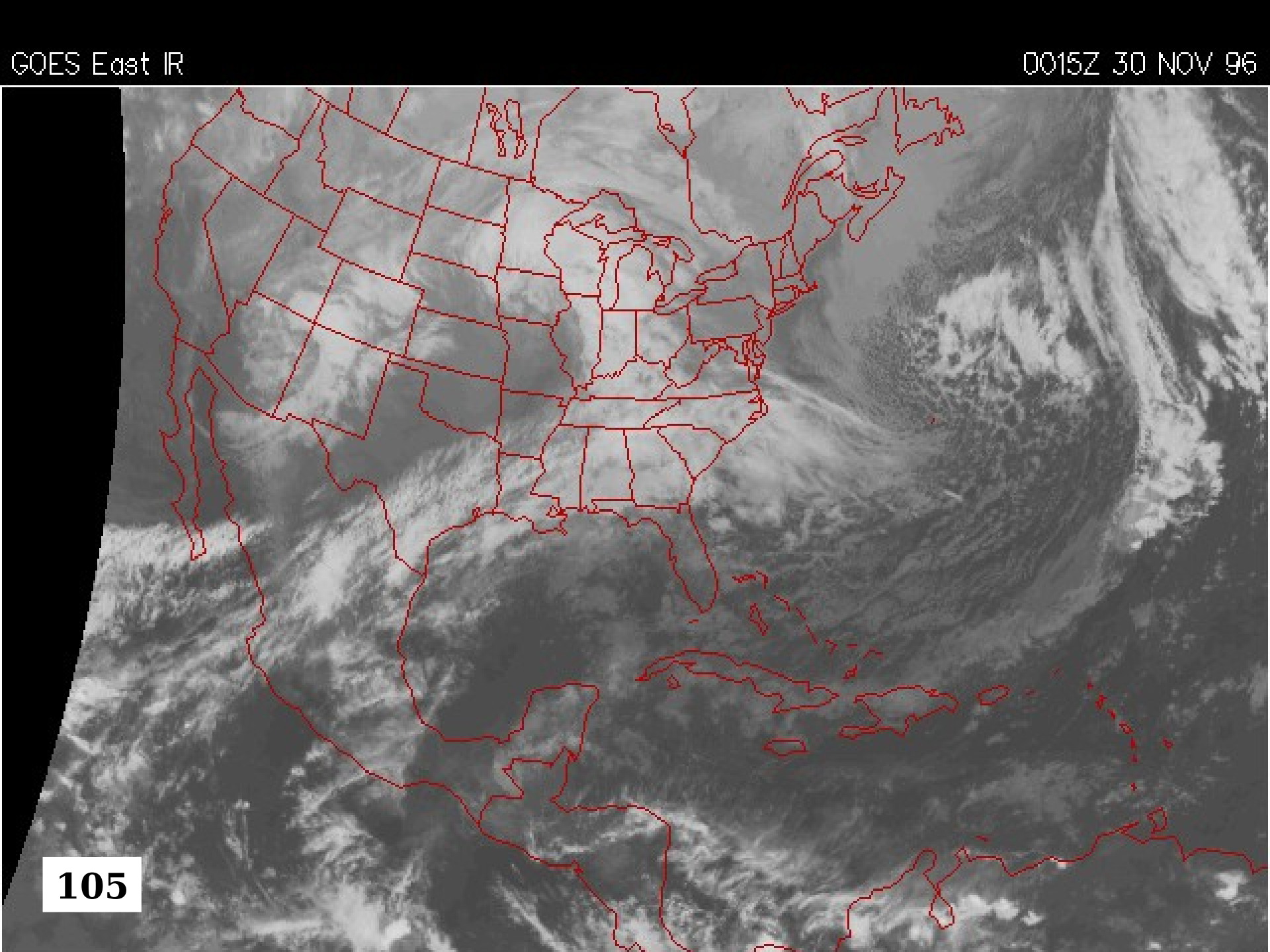
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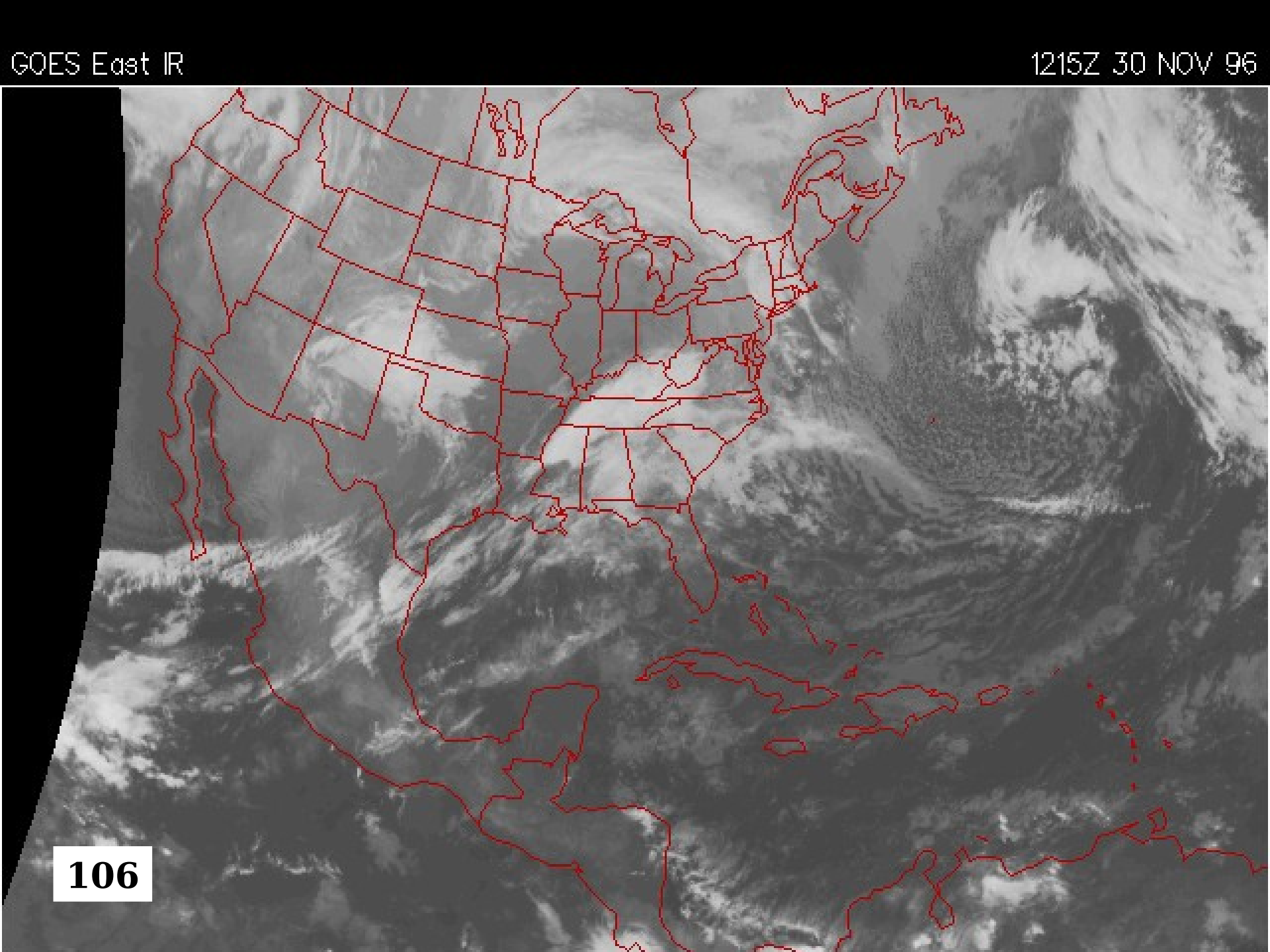

GOES East IR
1215Z 30 NOV 96
106

Analysis of Low Level Features

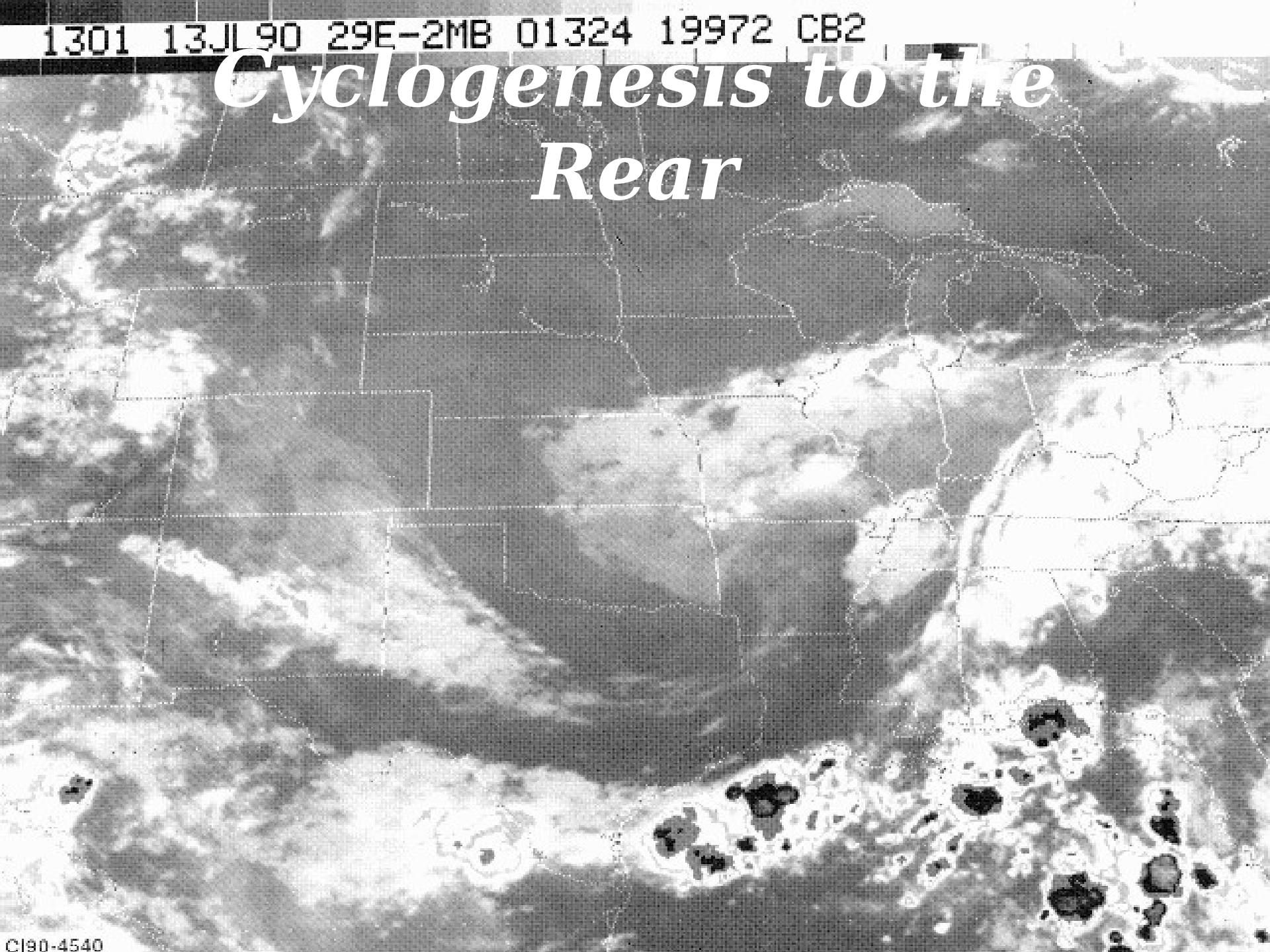
- General indicators
  - Intensifying
    - The frontal cloud band develops into a synoptic-scale comma cloud system.
    - The dry slot begins to form.
  - Occluding
    - The deformation zone and the dry slot become better defined.
    - Cold cloud tops most extensive.

Analysis of Low Level Features

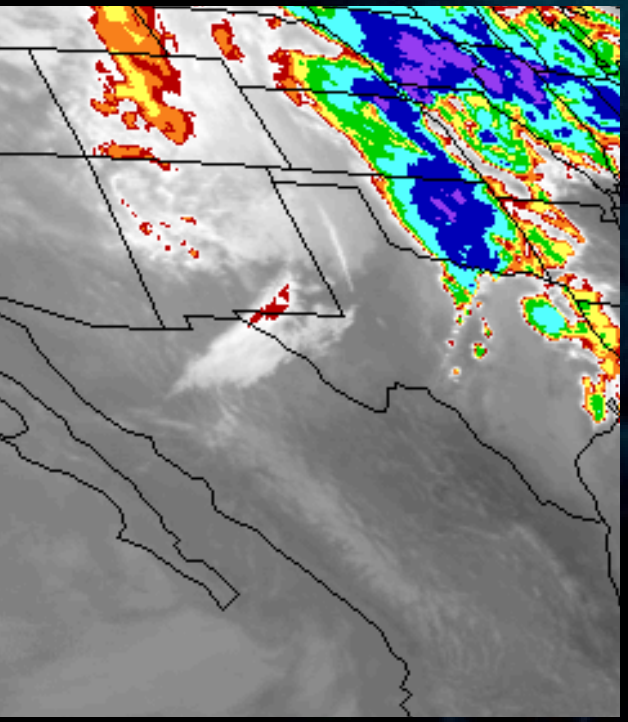
- Decaying
  - Dry slot wraps around the low.
  - The clouds fragment.

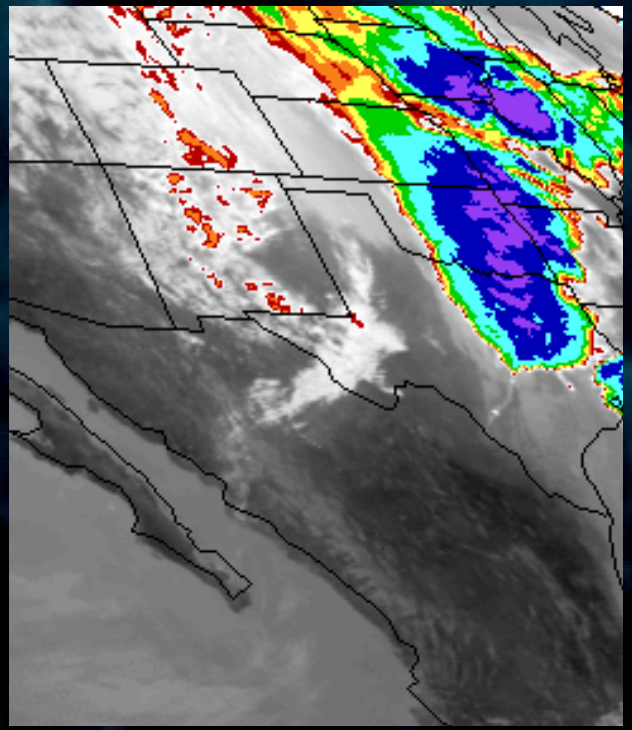
Analysis of Low Level Features

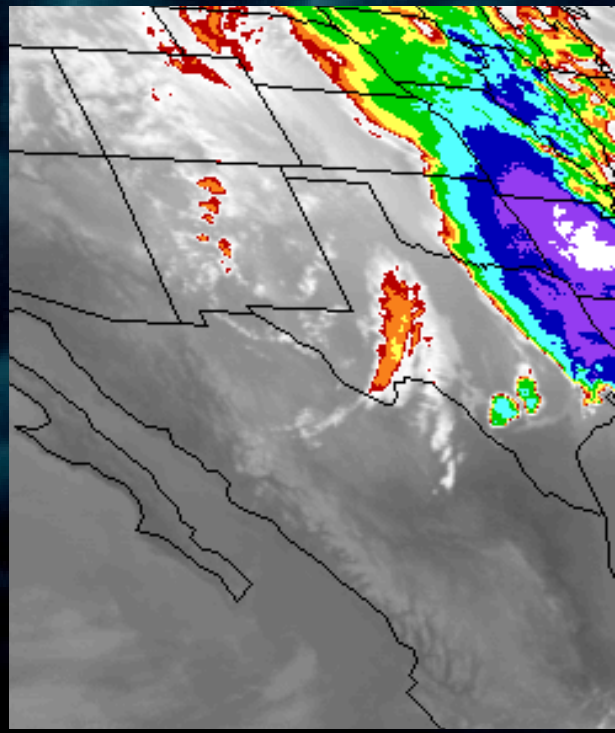
- Cyclogenesis to the rear of a baroclinic zone.
  - A new baroclinic zone forms west of the primary zone.
  - Surface cyclogenesis occurs as the baroclinic leaf transitions into a synoptic-scale comma cloud
  - As the transition begins, the vorticity and polar front jet pattern changes.
  - Cyclogenesis is accelerated if the baroclinic leaf transitions into the base of the long wave trough.

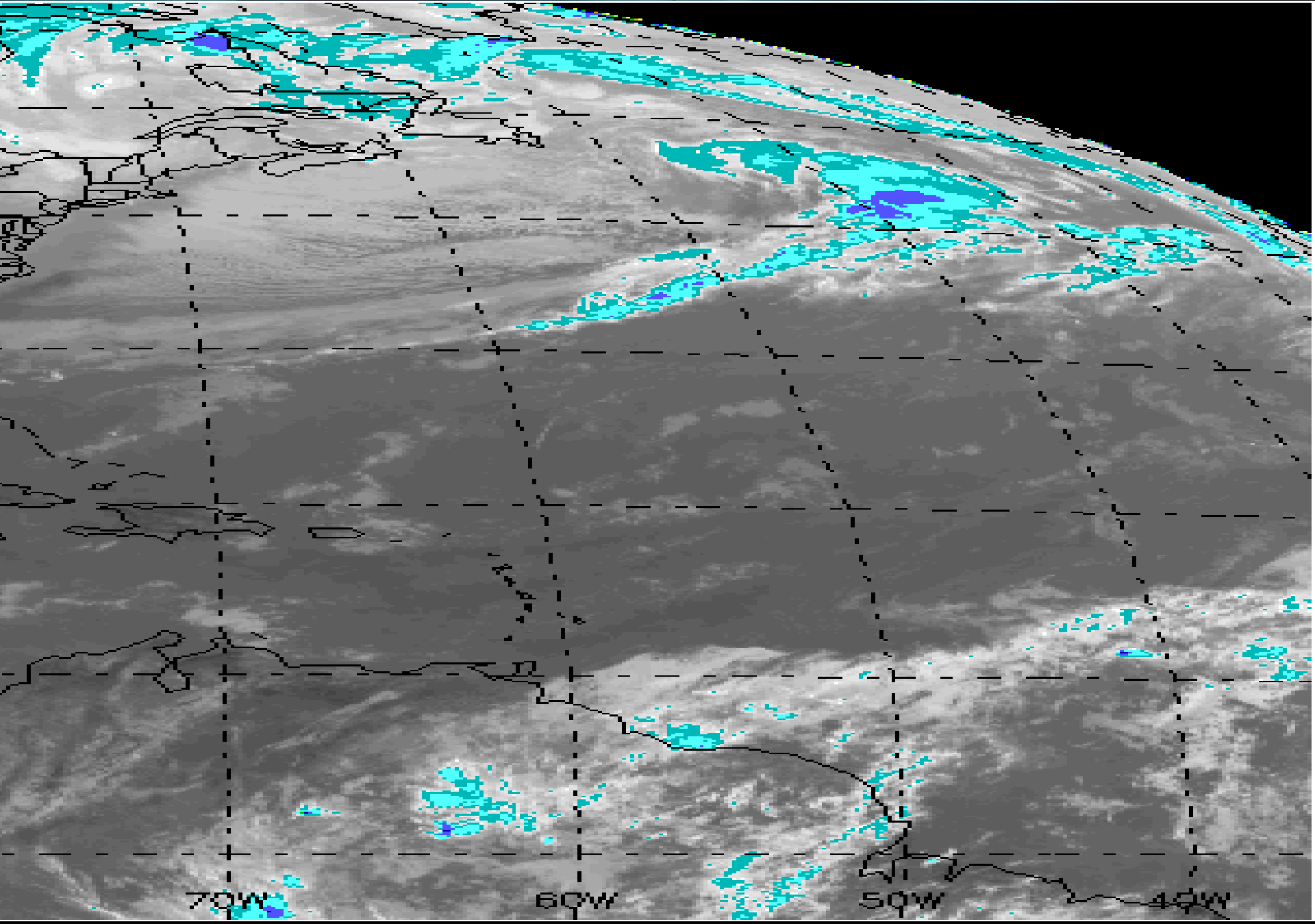

1301 13JL90 29E-2MB 01324 19972 CB2
Cyclogenesis to the Rear
CI90-4540

Cyclogenesis to the Rear









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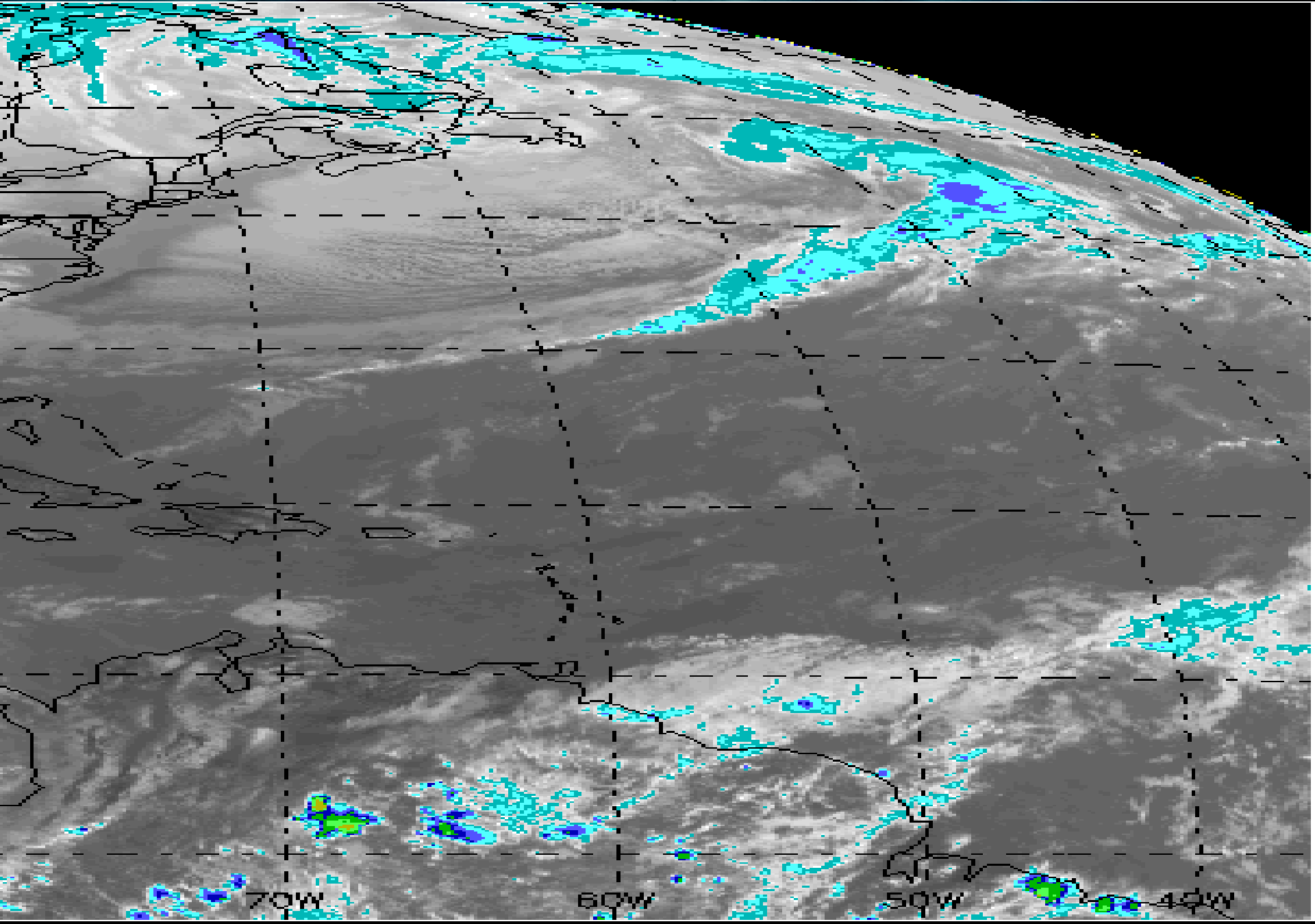

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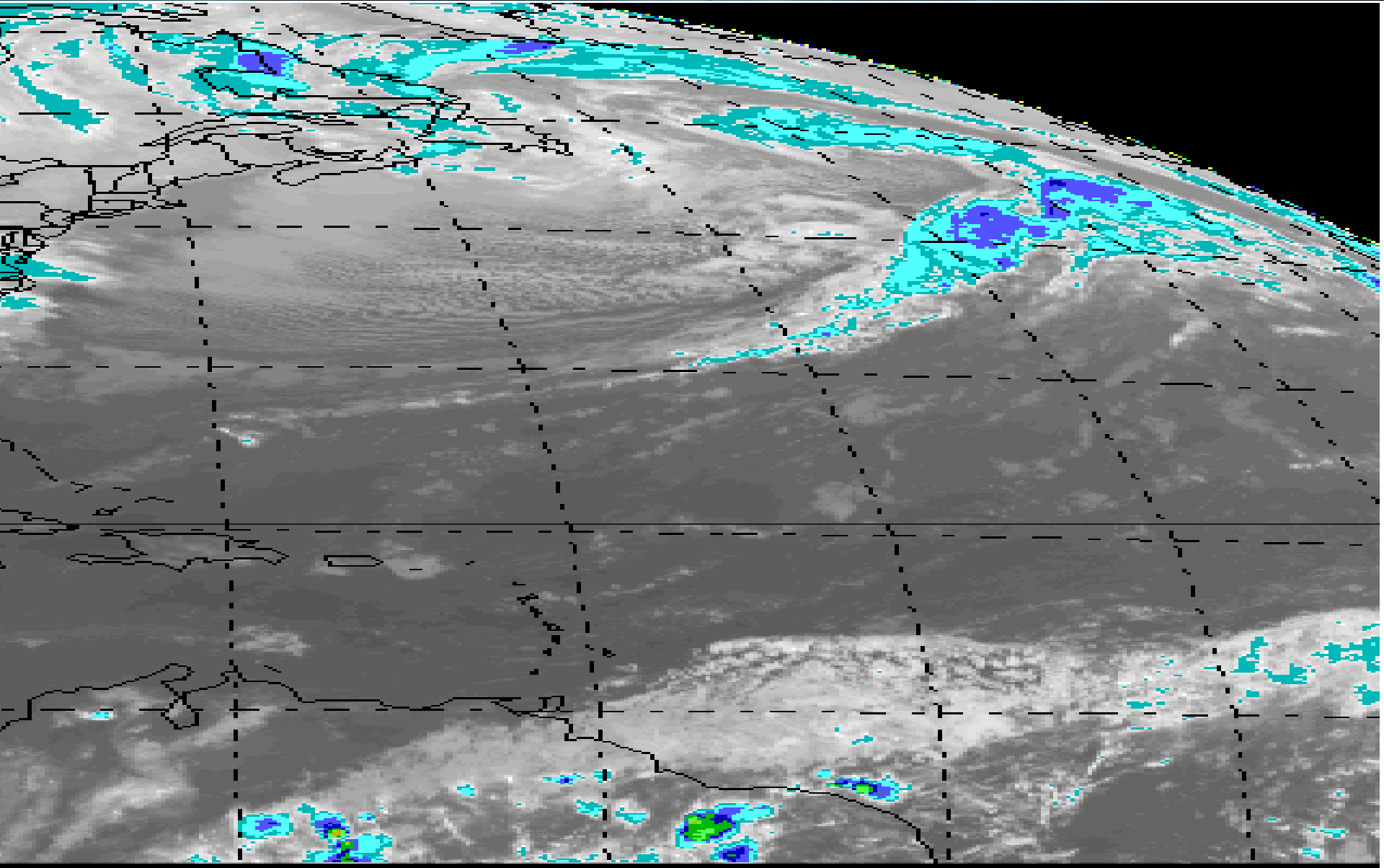
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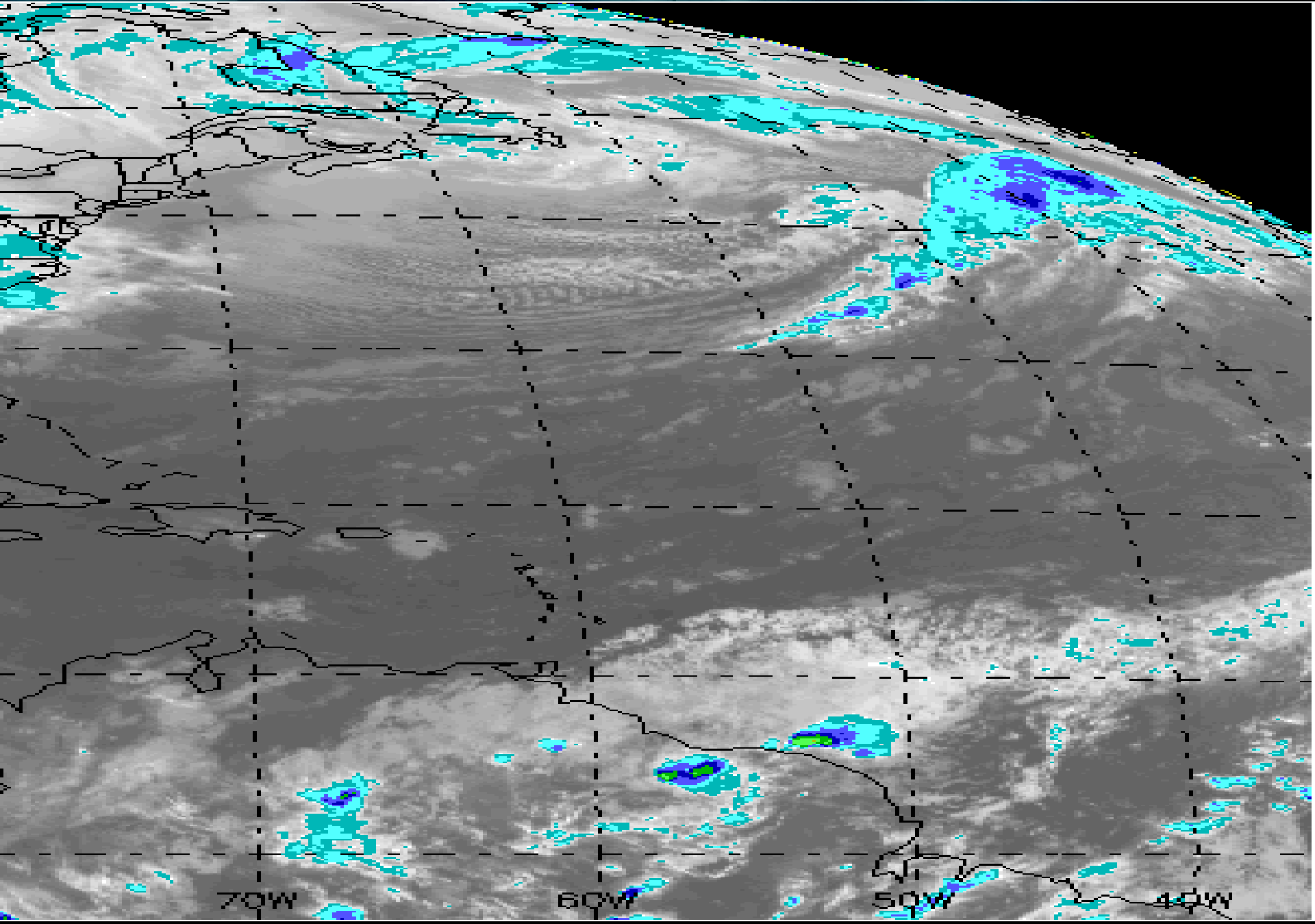

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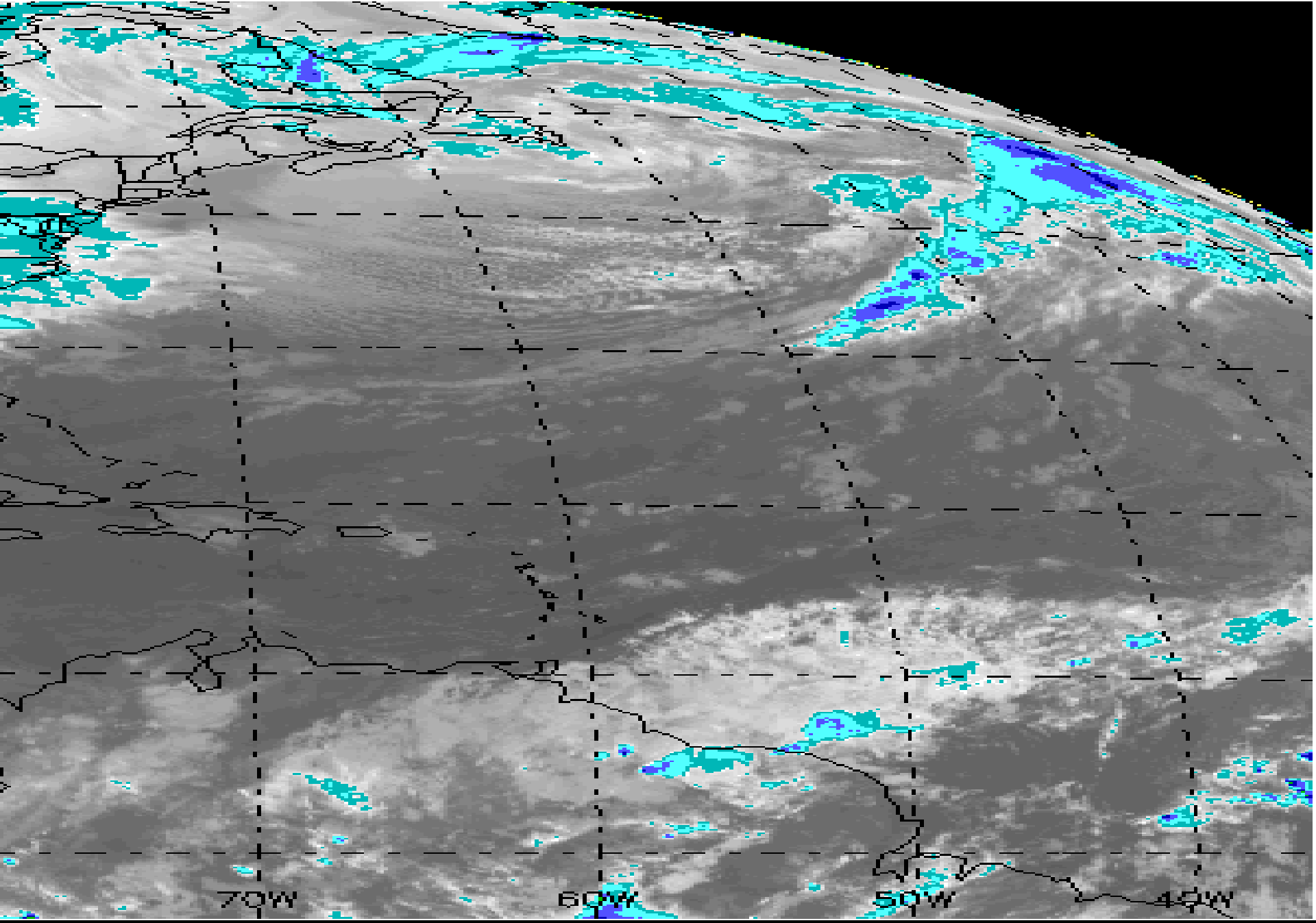
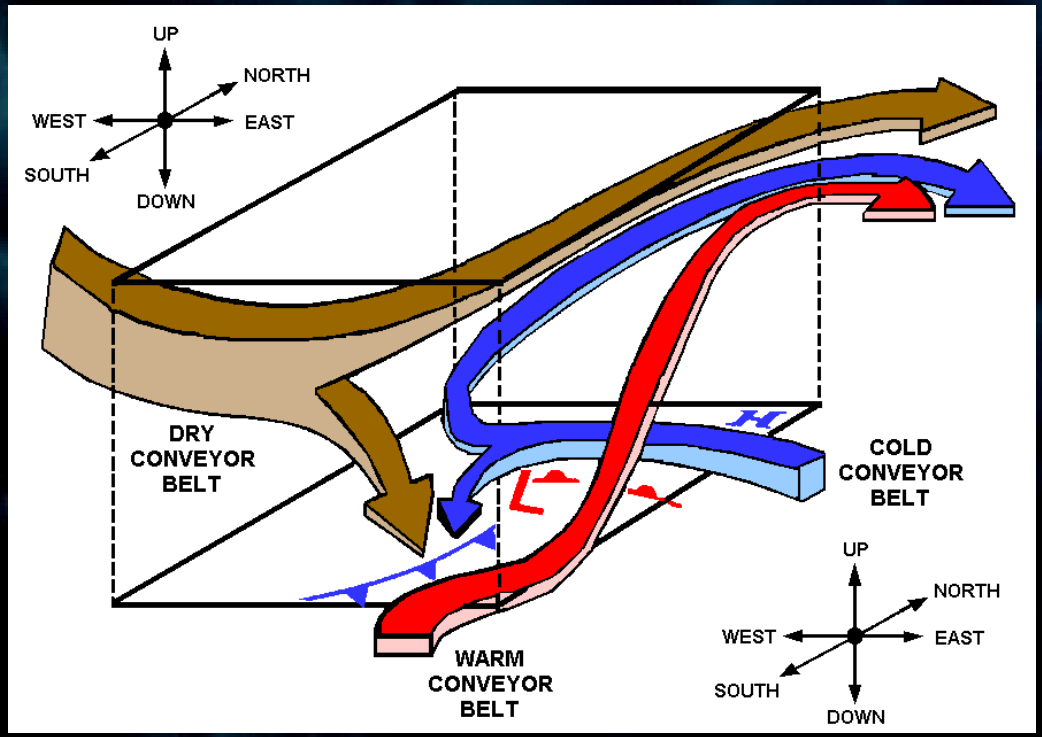


GOES8 Atlantic/Central Enh. IR Image
January 09, 1997 06GMT

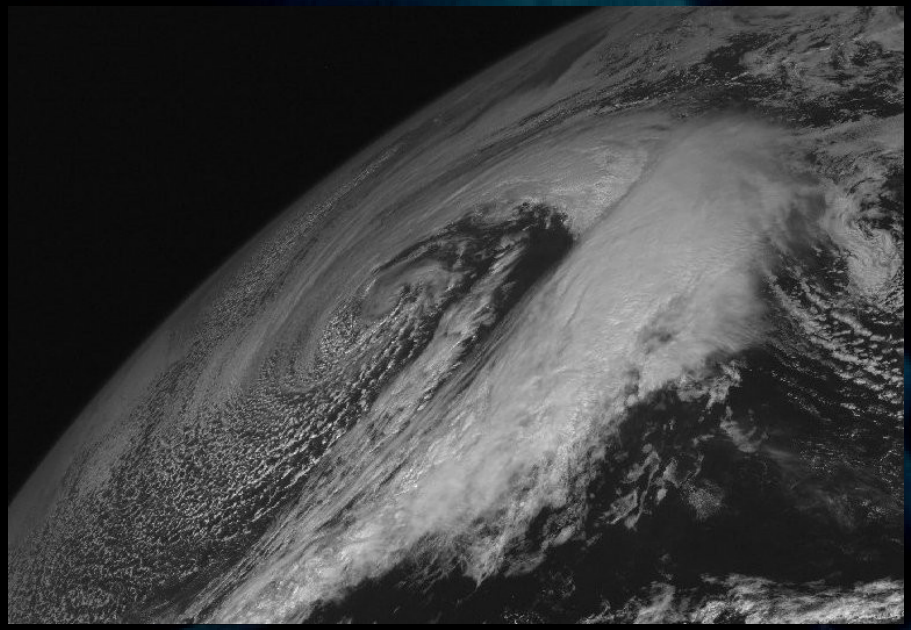
Analysis of Low Level Features

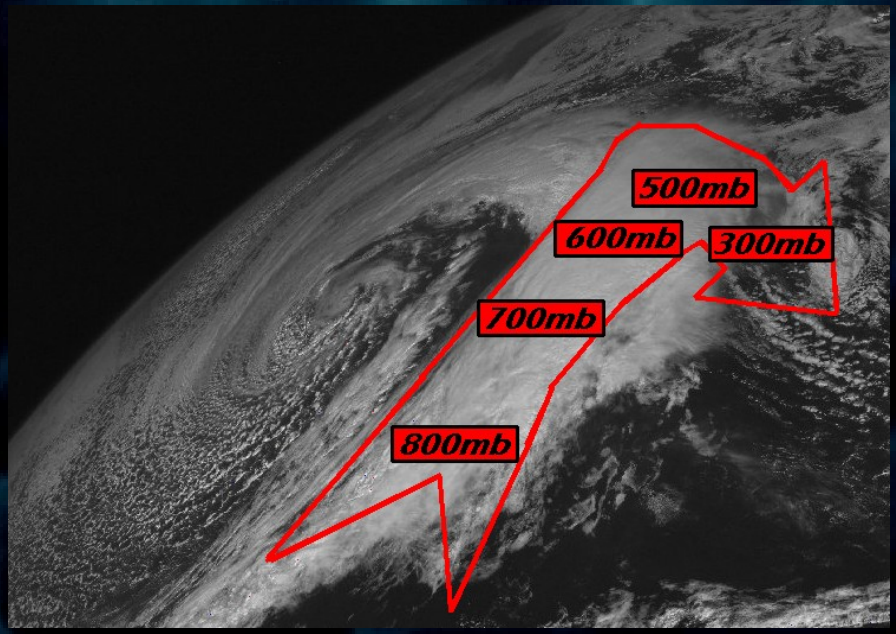
- Conveyor belts
  - Warm-air conveyor belt (WCB)
    - It is associated with the baroclinic zone cloud system.
    - The highest (coldest) cloud tops are associated with the ascent of the WCB over the warm front.
  - Cold-air conveyor belt (CCB)
    - Clouds in the comma head are due to the ascent of moisture west of the low.
    - SC and ST clouds form near the low due to boundary layer convergence (BLC), even though widespread subsidence occurs behind the front.

Conveyor Belts

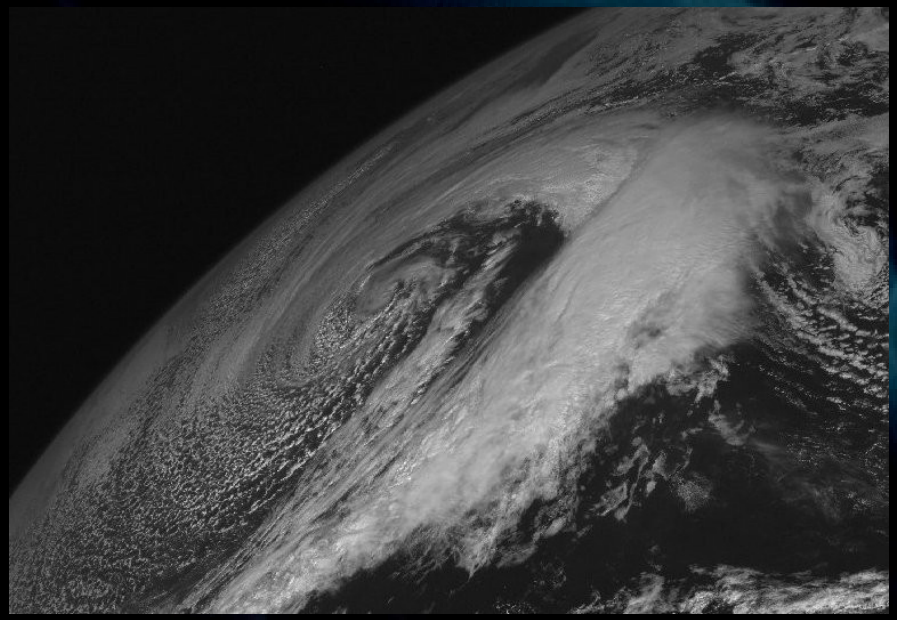


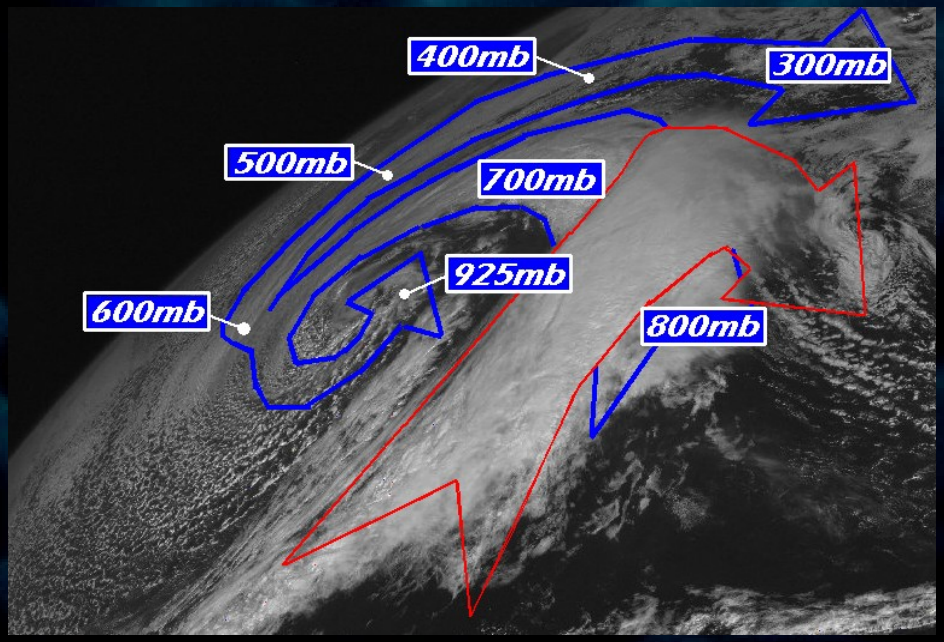
Warm Conveyor Belt





Cold Conveyor Belt

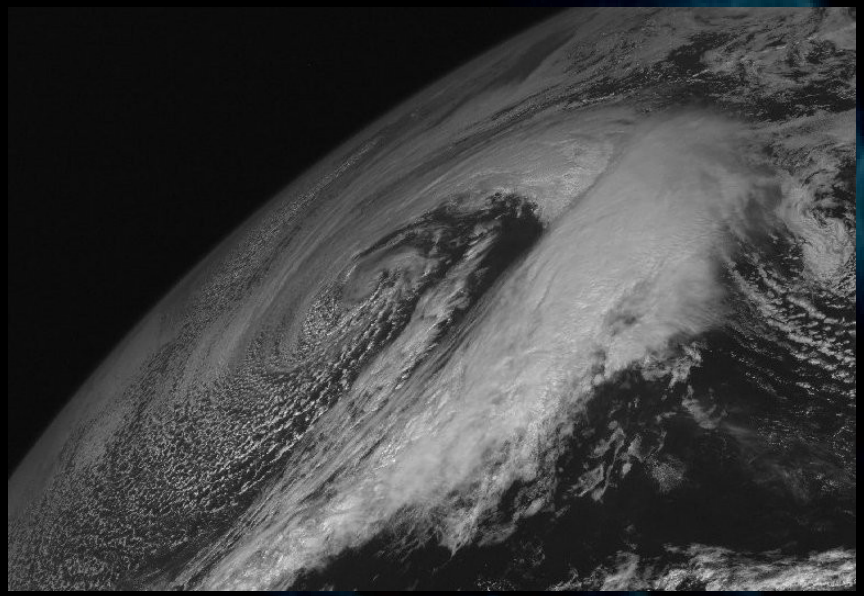


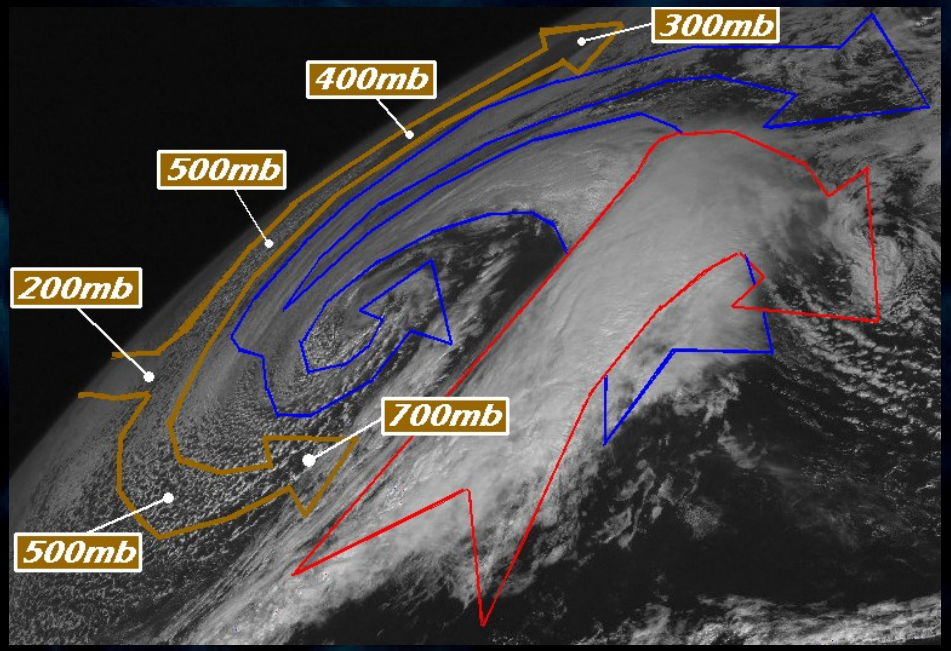


Analysis of Low Level Features

- Dry-air conveyor belt (DCB) is the boundary between the WCB and DCB seen as smooth border north of the low (upper-level deformation zone).

Dry Conveyor Belt

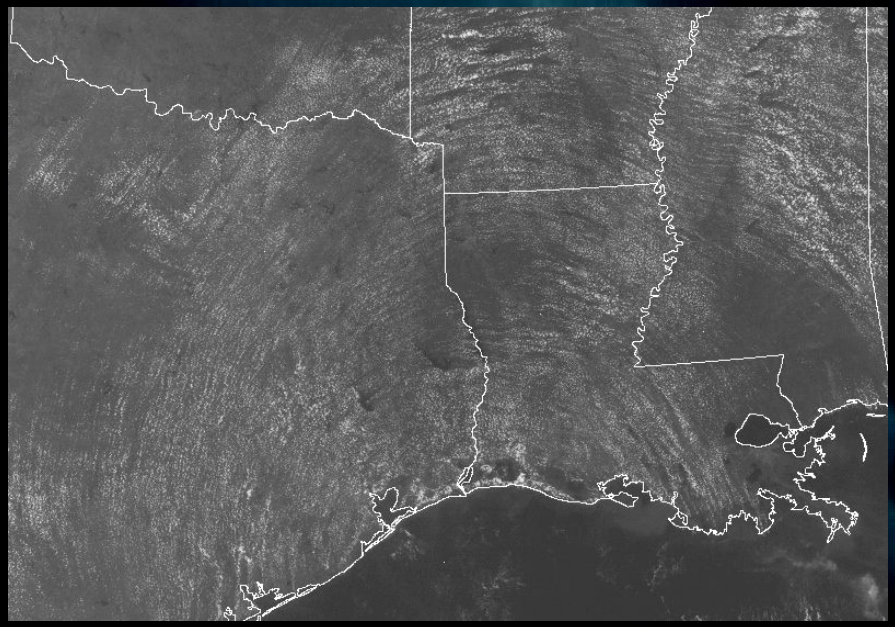


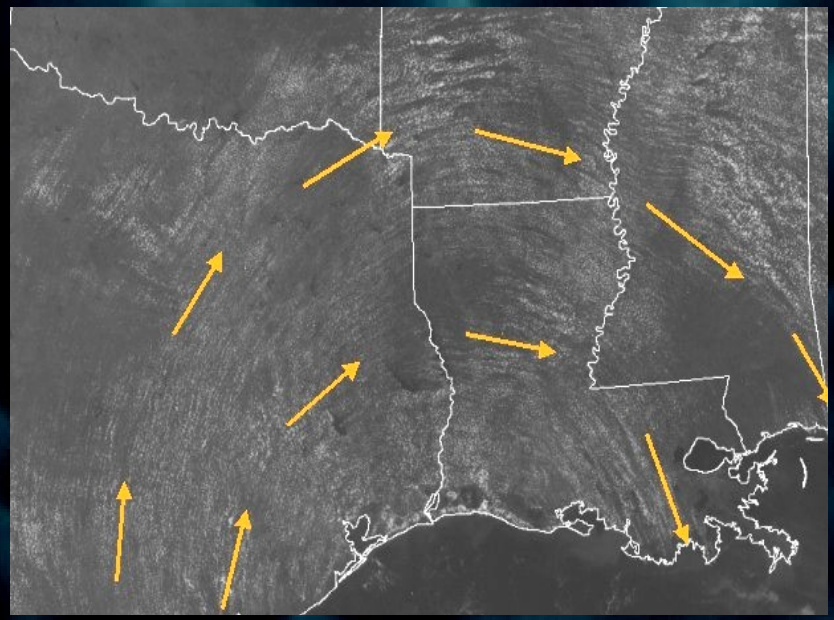


Analysis of Low Level Features

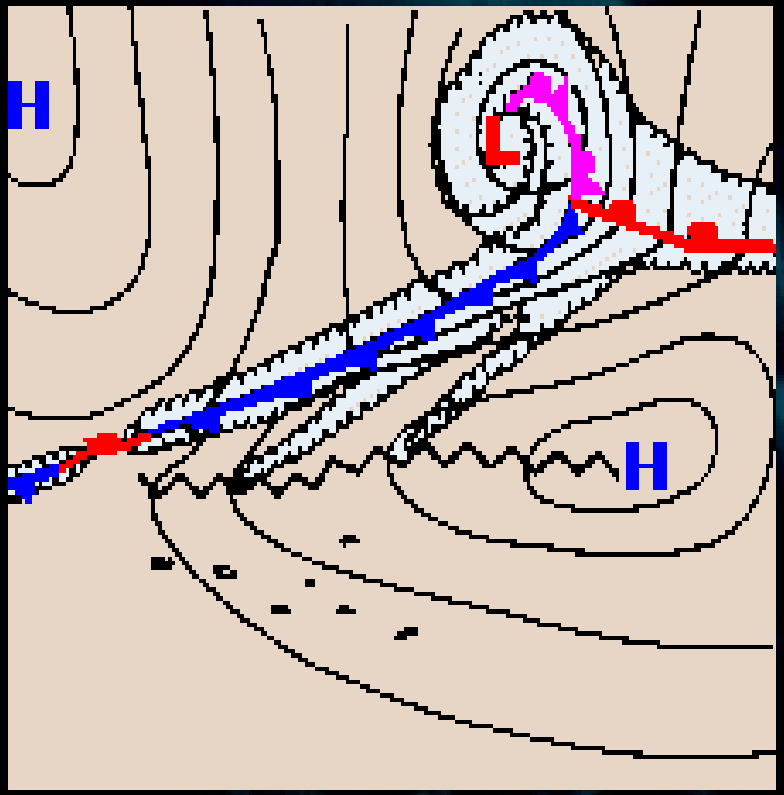
- Surface highs and ridges
  - Baroclinic highs and ridges
    - High cloudiness normally extends from an upstream low-pressure system over the u pper level short-wave ridge axis.
    - High centers over land are determined by orientation, wind flow, of low clouds.
      - Late fall to early spring
        - » SC lines and lake effect snow squalls develop (offshore flow).
        - » Fog, stratus, and SC pushed up against terrain (upslope).

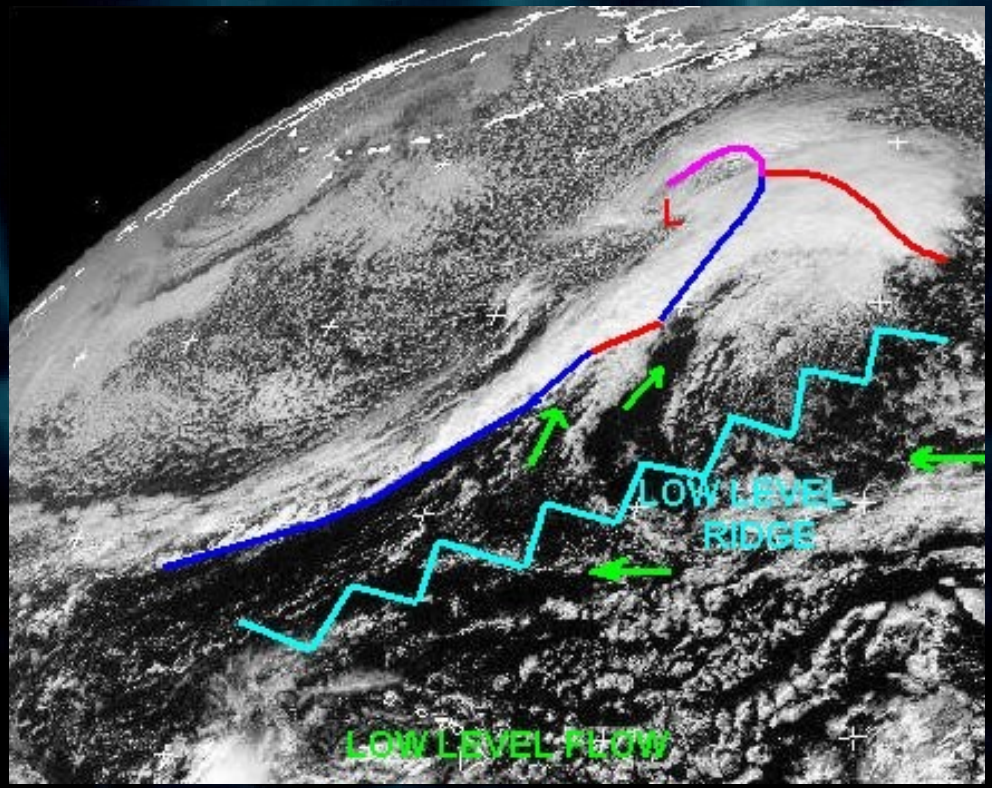
Surface High



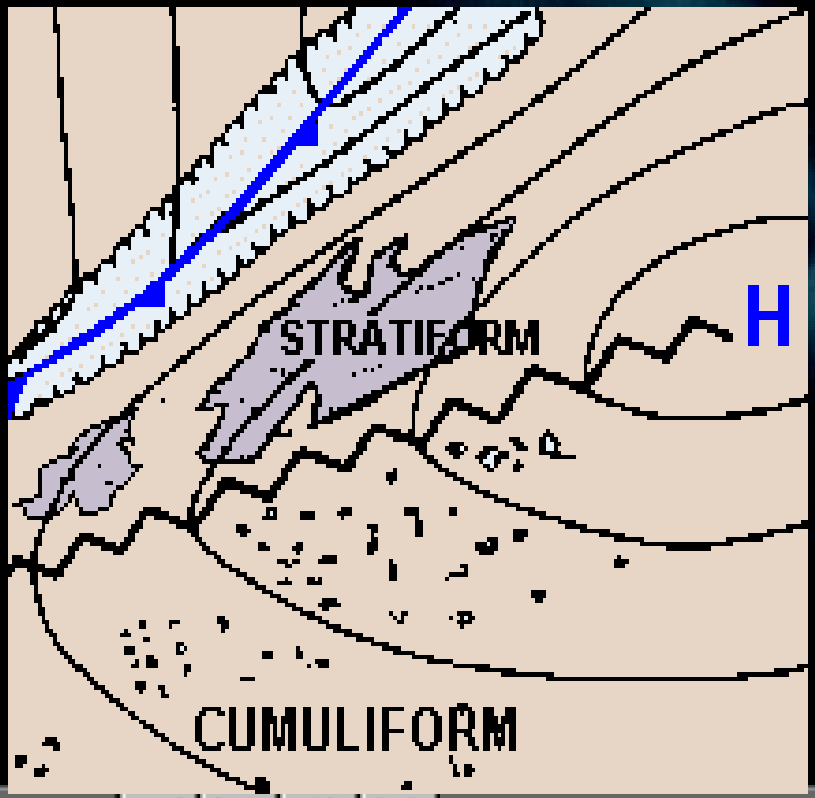


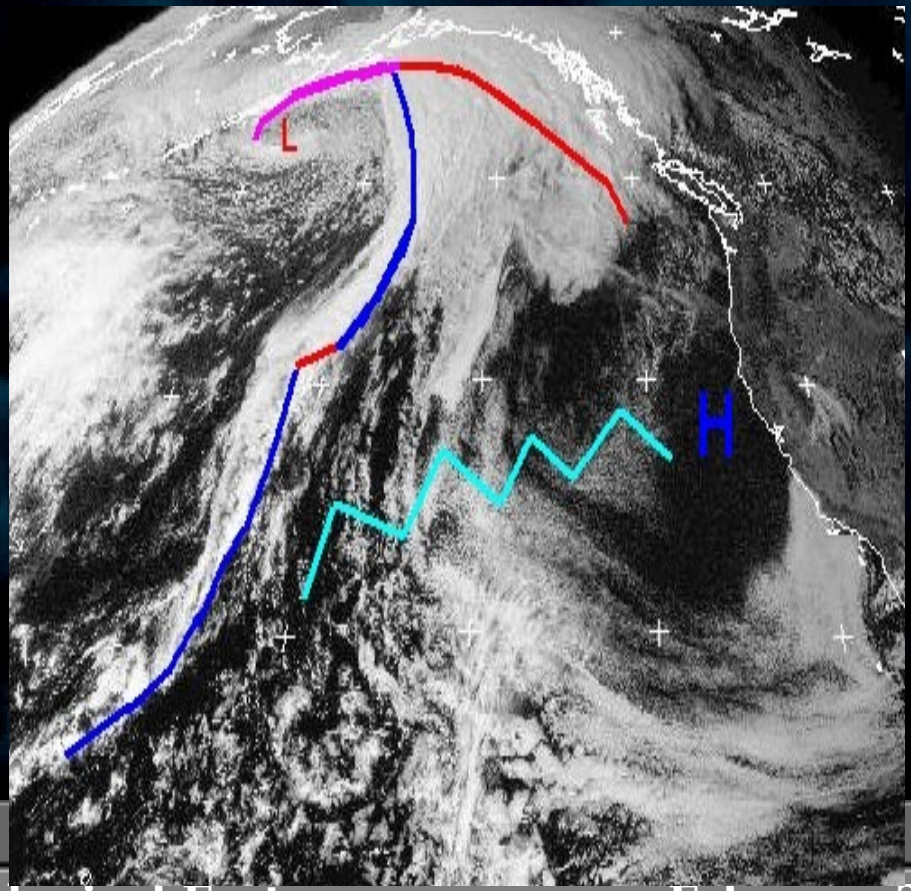
Surface Ridge Using Cloud Fingers



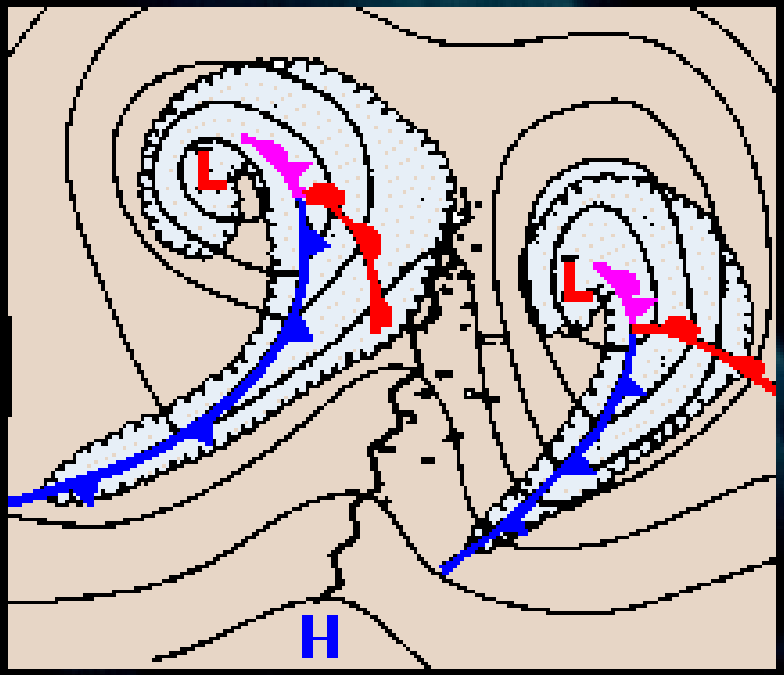


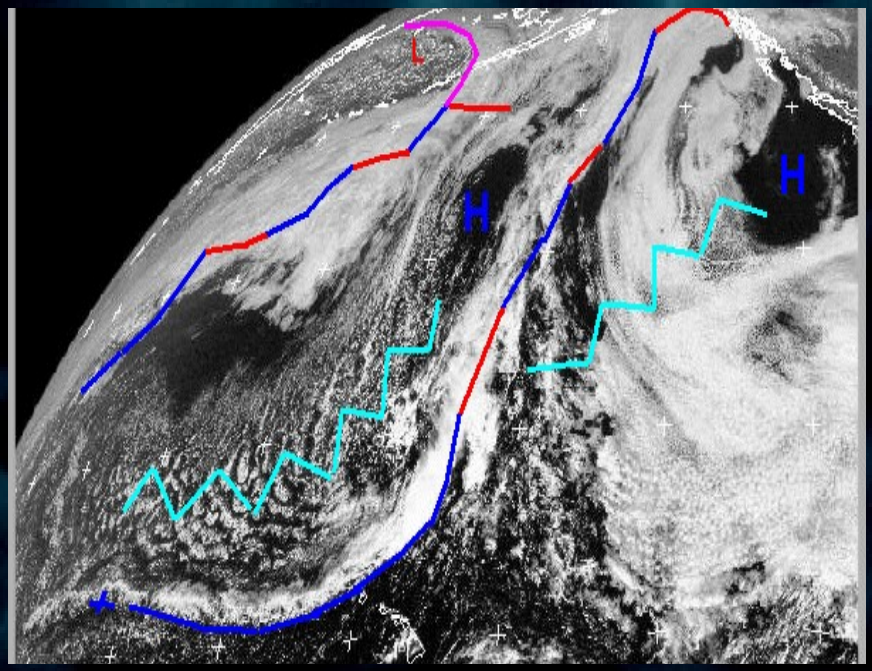
Surface Ridge Using Cloud Character

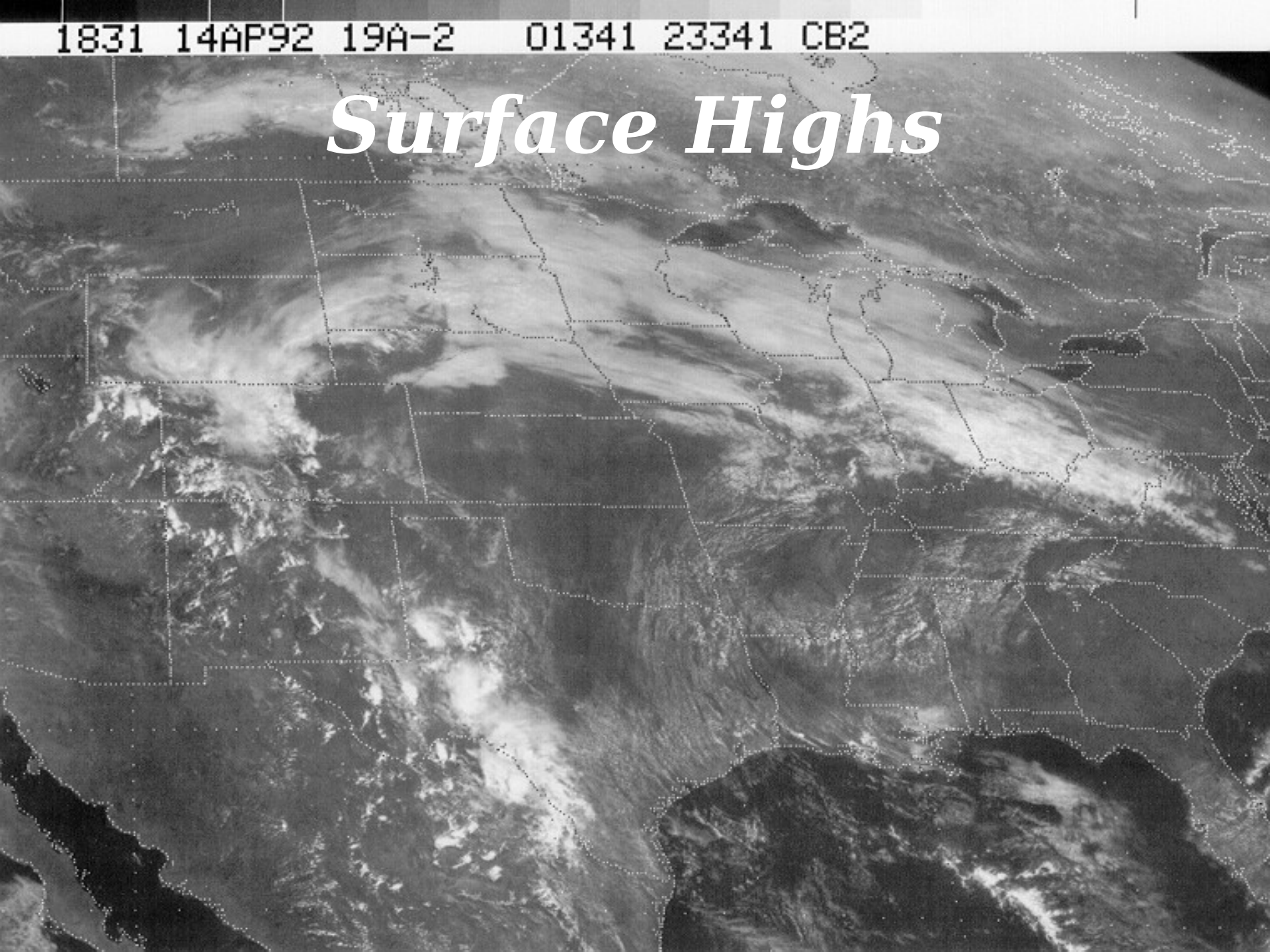


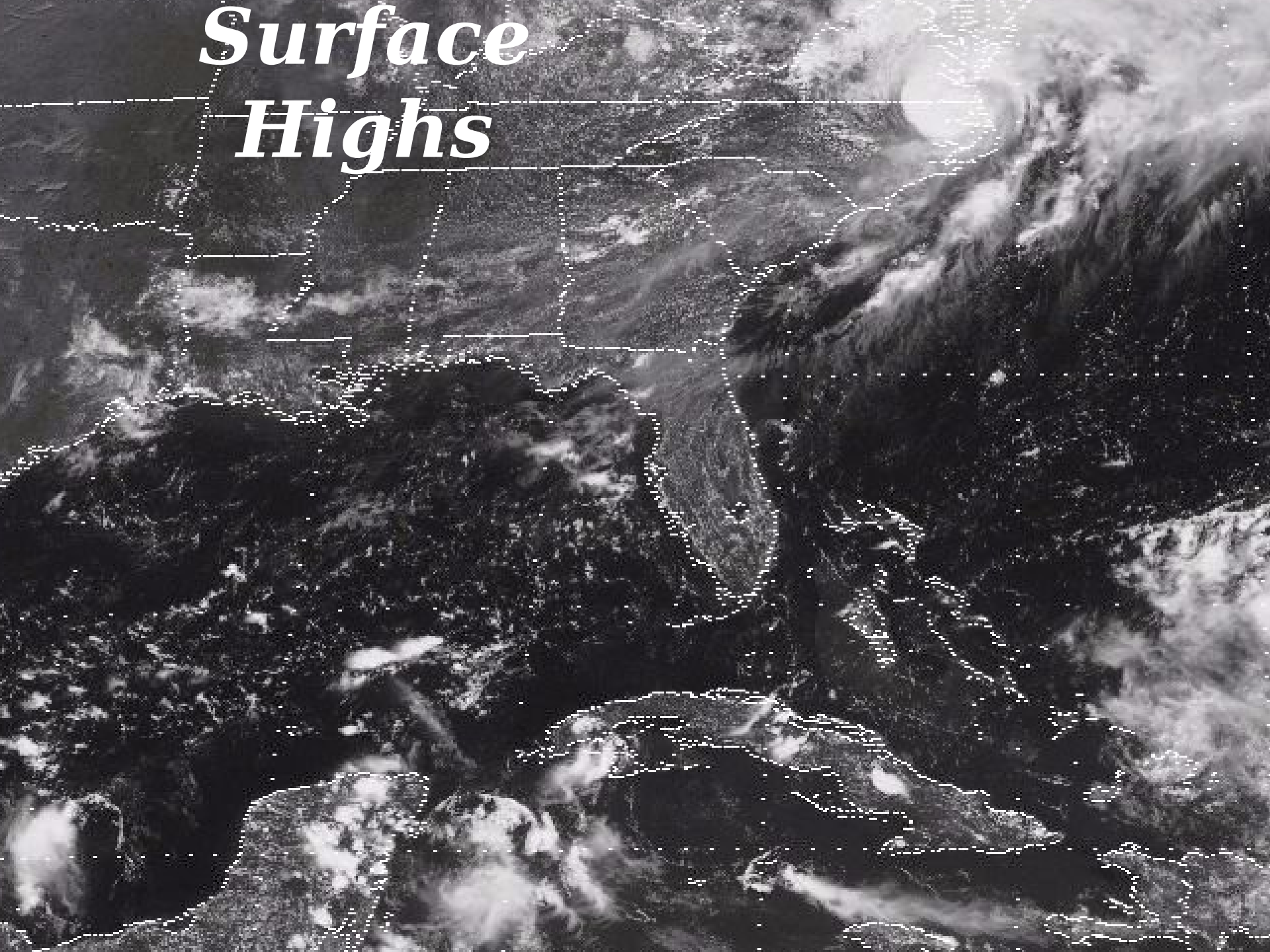


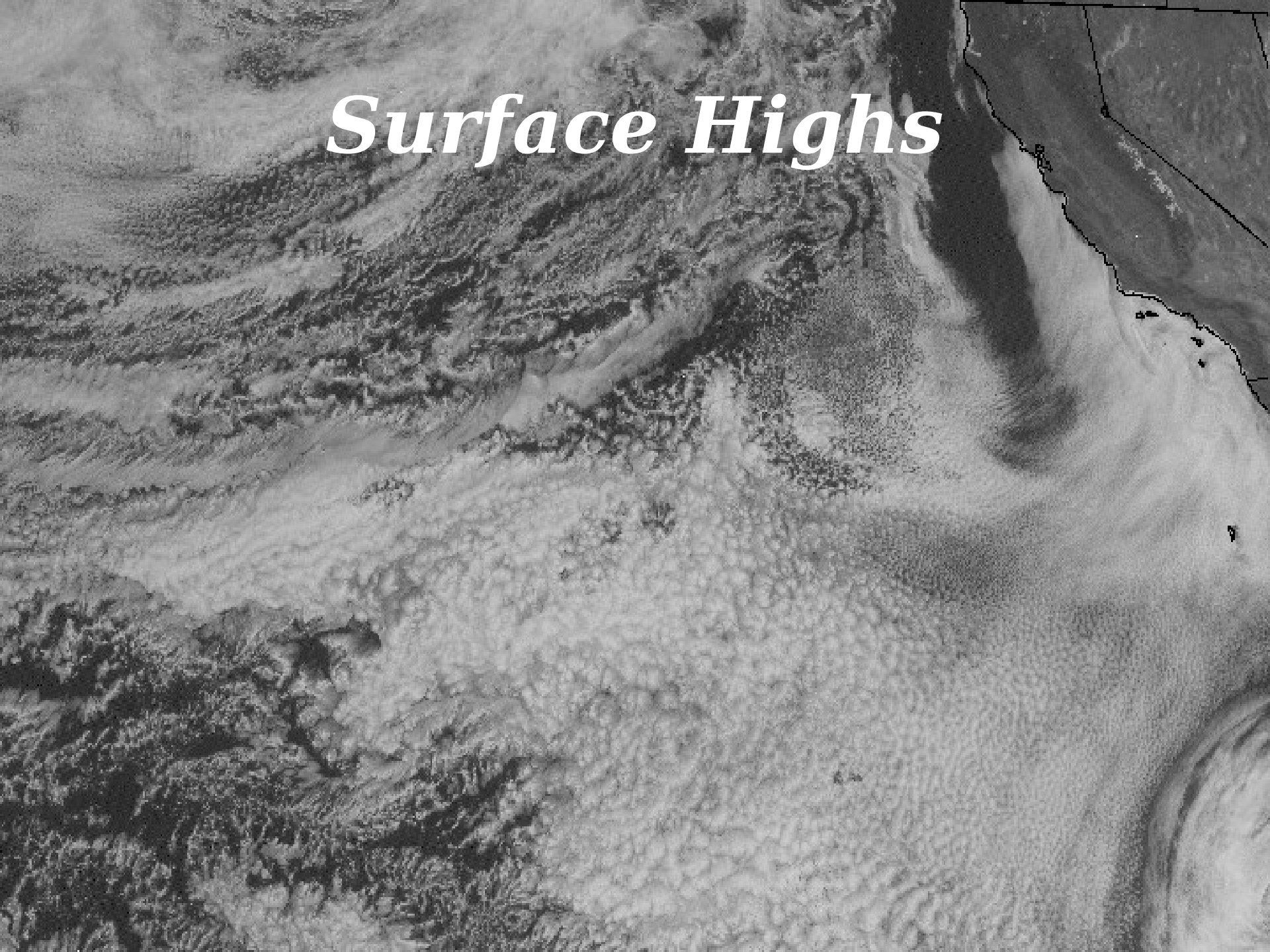
Surface Ridge Using 2 Weather Systems

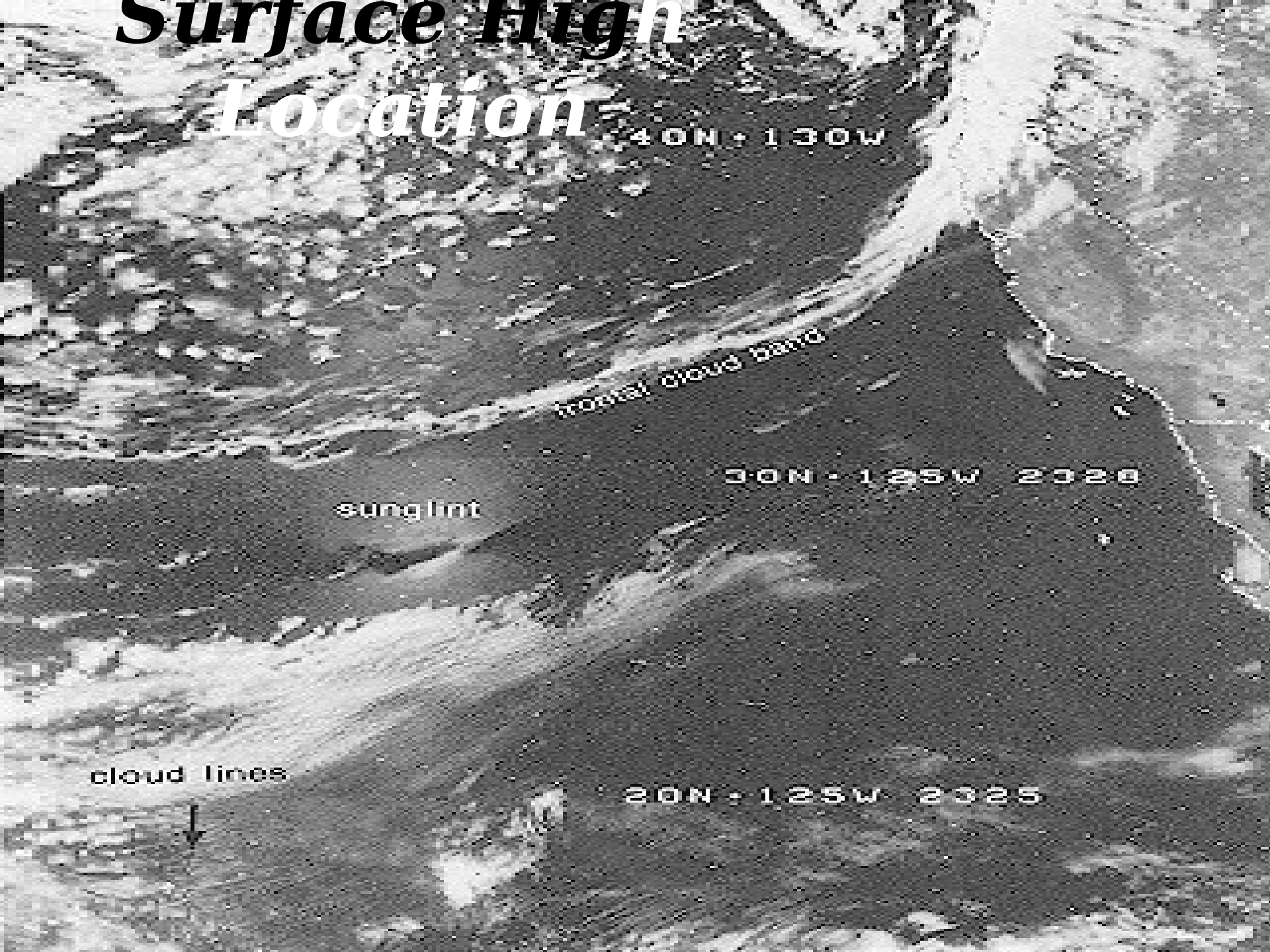





1831 14AP92 19A-2 01341 23341 CB2
Surface Highs


Surface
Highs


Surface Highs


Surface High
Location
40N 130W
frontal cloud band
30N 125W 2328
sunglint
cloud lines
20N 125W 2325

Analysis of Low Level Features

- Mid-spring to mid-fall
  - » With warmer land, clearing occurs on the leeside of lakes.
  - » East portion of highs generally clear, with more vertically developed convective clouds on the western half.

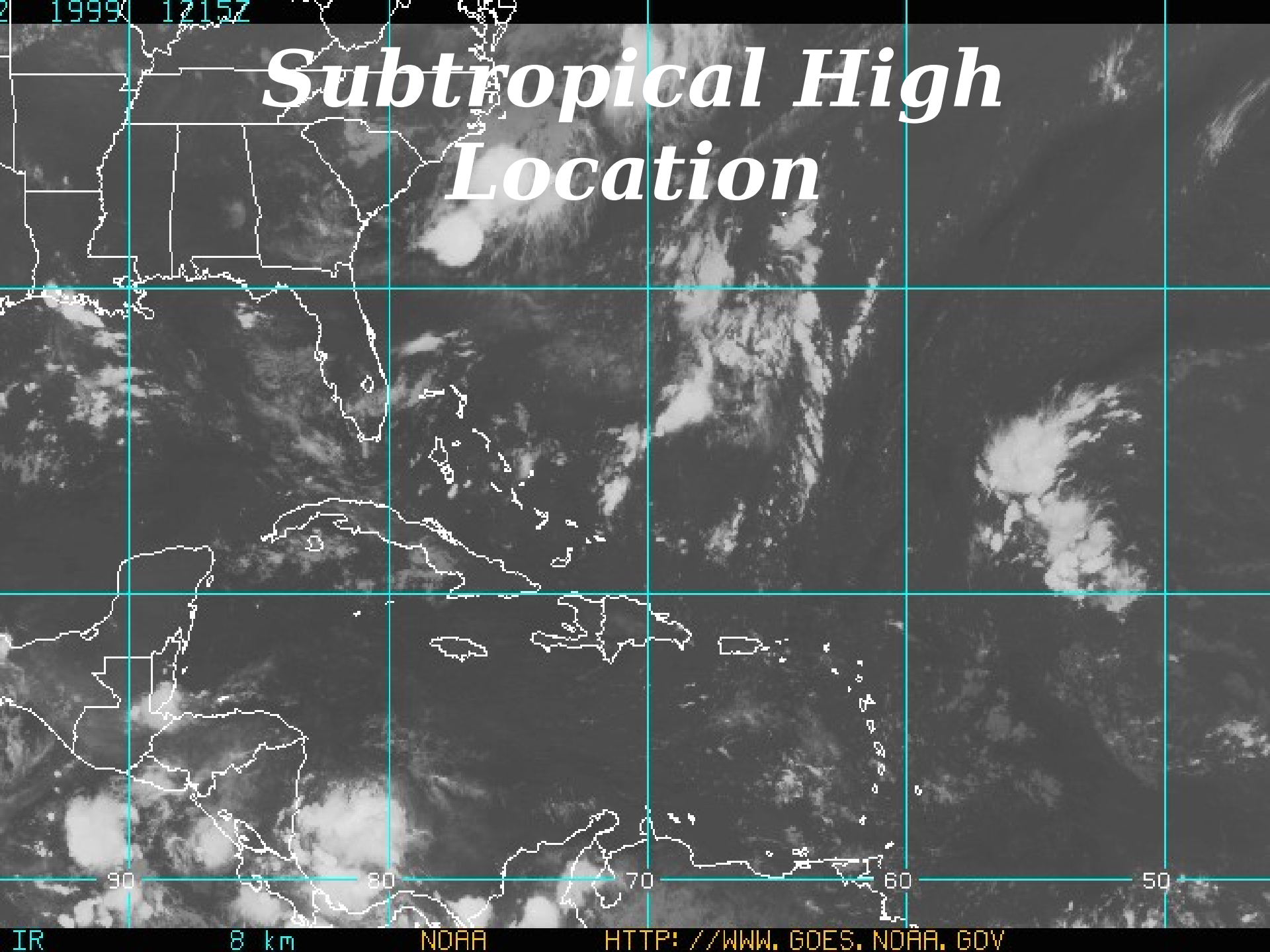
- High centers over water are located based on cloud patterns and low-pressure center position.
  - In the southern half of a high, closed-cell stratocumulus is normally present with a clear zone to the west.
  - The high center is normally located in the eastern portion of the clear zone.

Analysis of Low Level Features

- Subtropical highs
  - Identified on imagery by the flow pattern in the surrounding region.
  - Systems move west to east in mid-latitudes; East to west in the tropics.
  - A subtropical high is located between these regimes
    .
  - SC found usually east-southwest of the high and is common off of west coasts.
  - Ridge axis is found the center of strongest anticyclonic turning in the cloud lines and streets to the west of the high.

Subtropical High
Location

Subtropical High Location

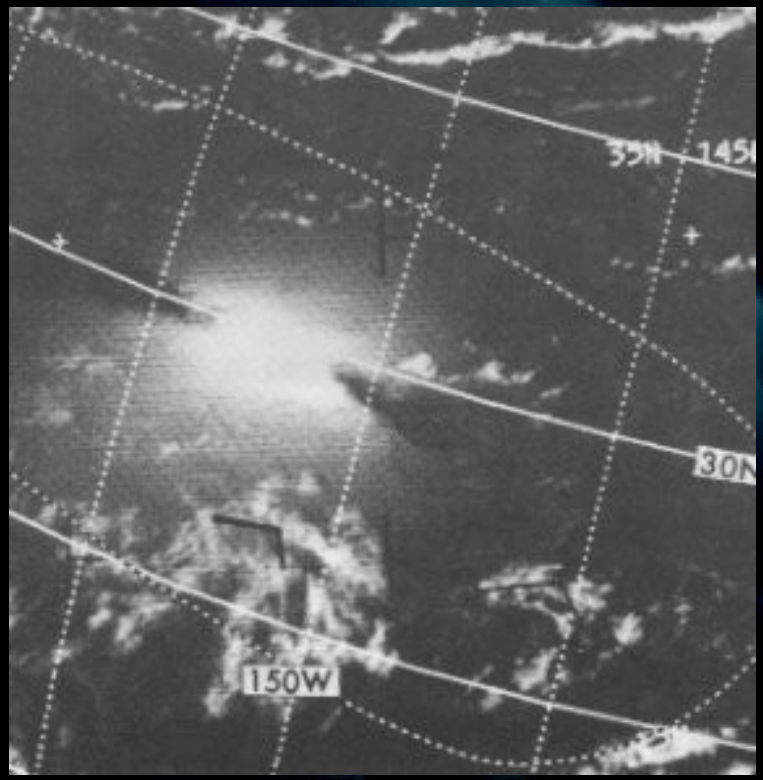

2 1999 12152
Subtropical High Location
90
80
70
60
50
IR 8 km NOAA HTTP://WWW.GOES.NOAA.GOV

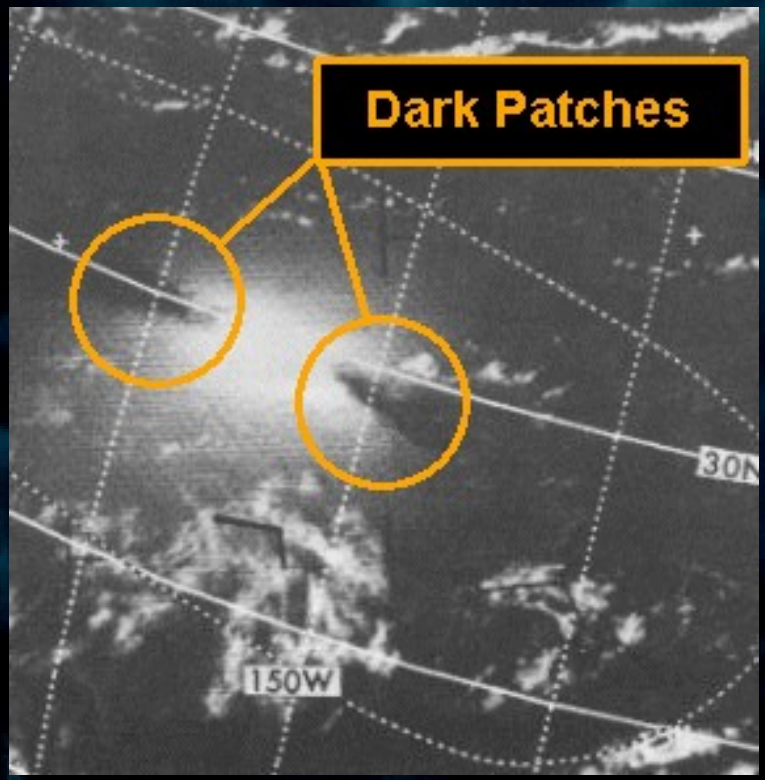
Subtropical High Location

Analysis of Low Level Features

- Cloud fingers identified by SC lines indicates a subtropical ridge to the south.
- A dark **"V" notch** in the sunglint pattern indicates the location of the ridge axis. Sunglint also indicates calm waters, indicating weak flow.

Using Sun Glint

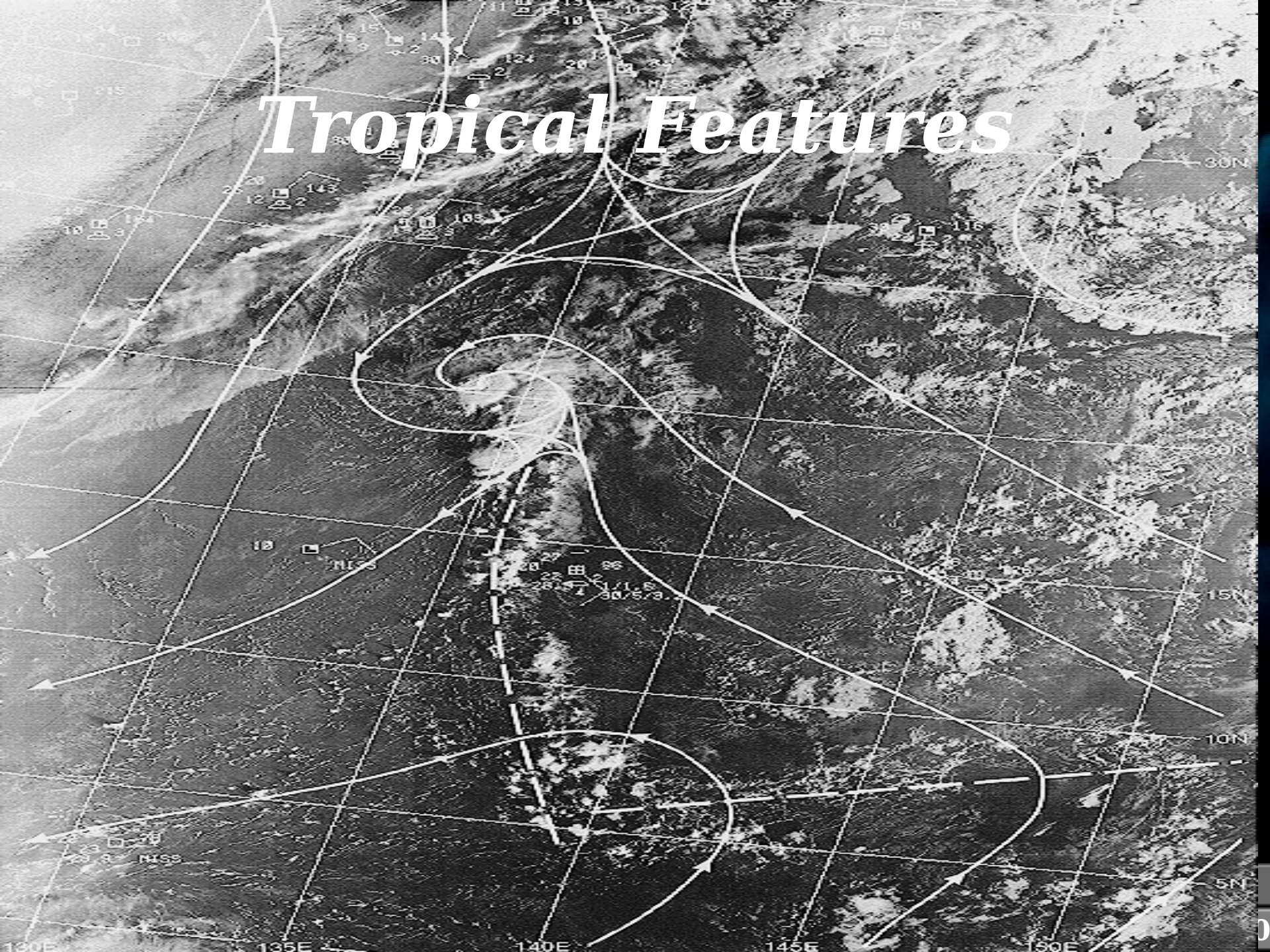




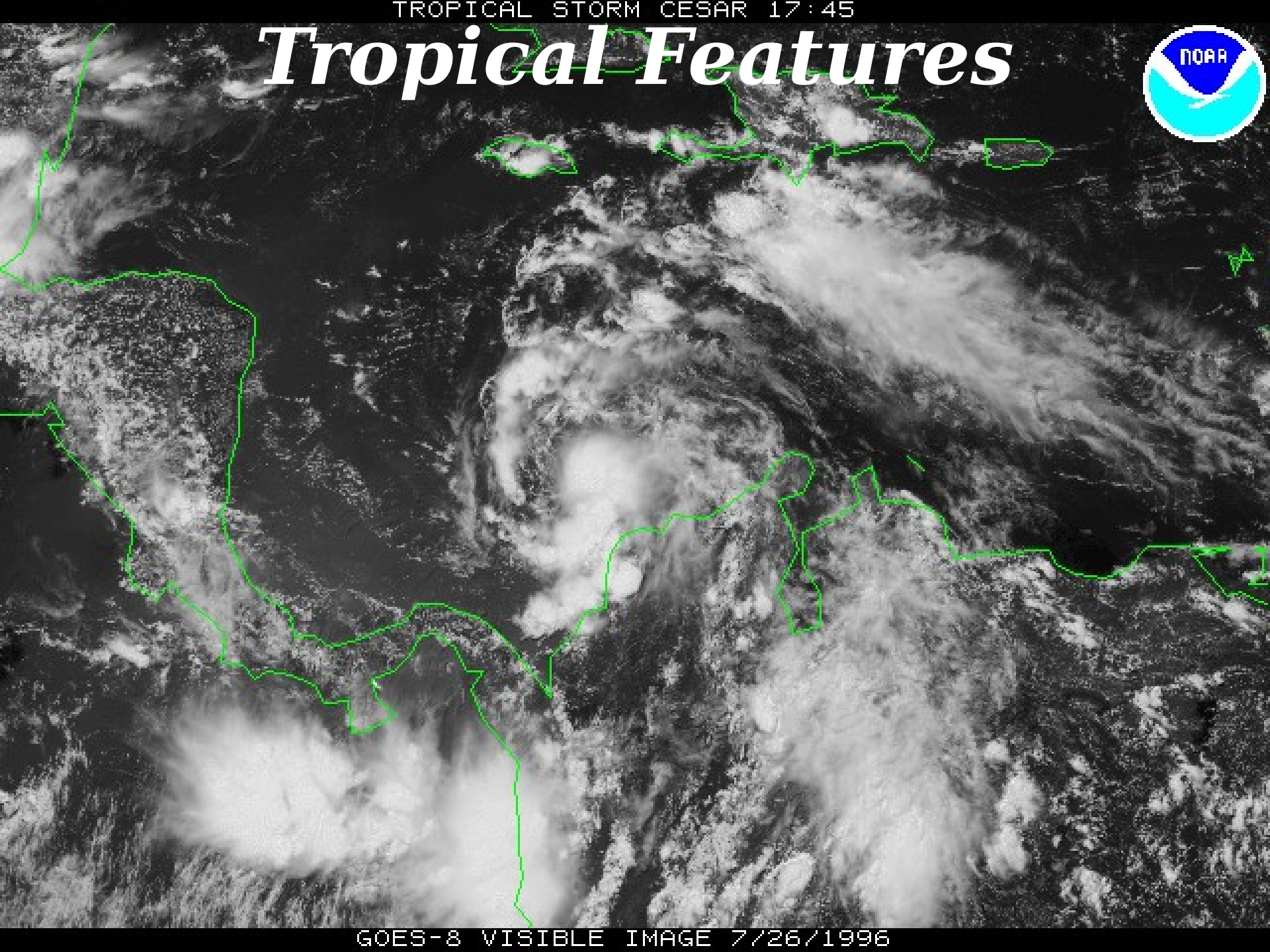
Analysis of Low Level Features

- Tropical weather systems
  - The structure of a tropical cyclone.

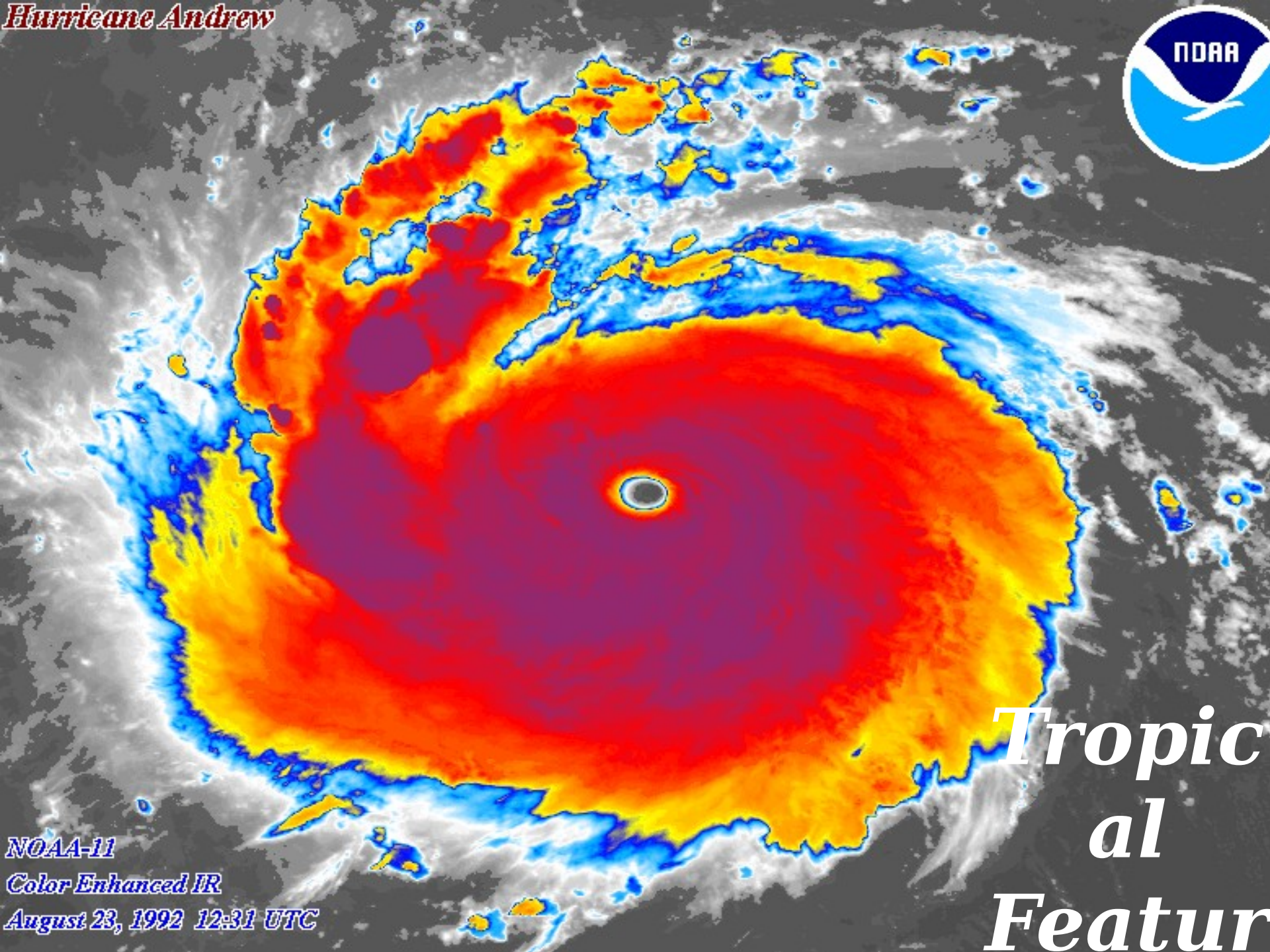
    Instructor reference
  - The life cycle of a tropical cyclone.
  - Using satellite imagery, we are now able to closely monitor the development and movement of storms.
  - Using animated imagery is especially useful.
  - The use of enhancement curves can also help with forecasting hurricane movement.

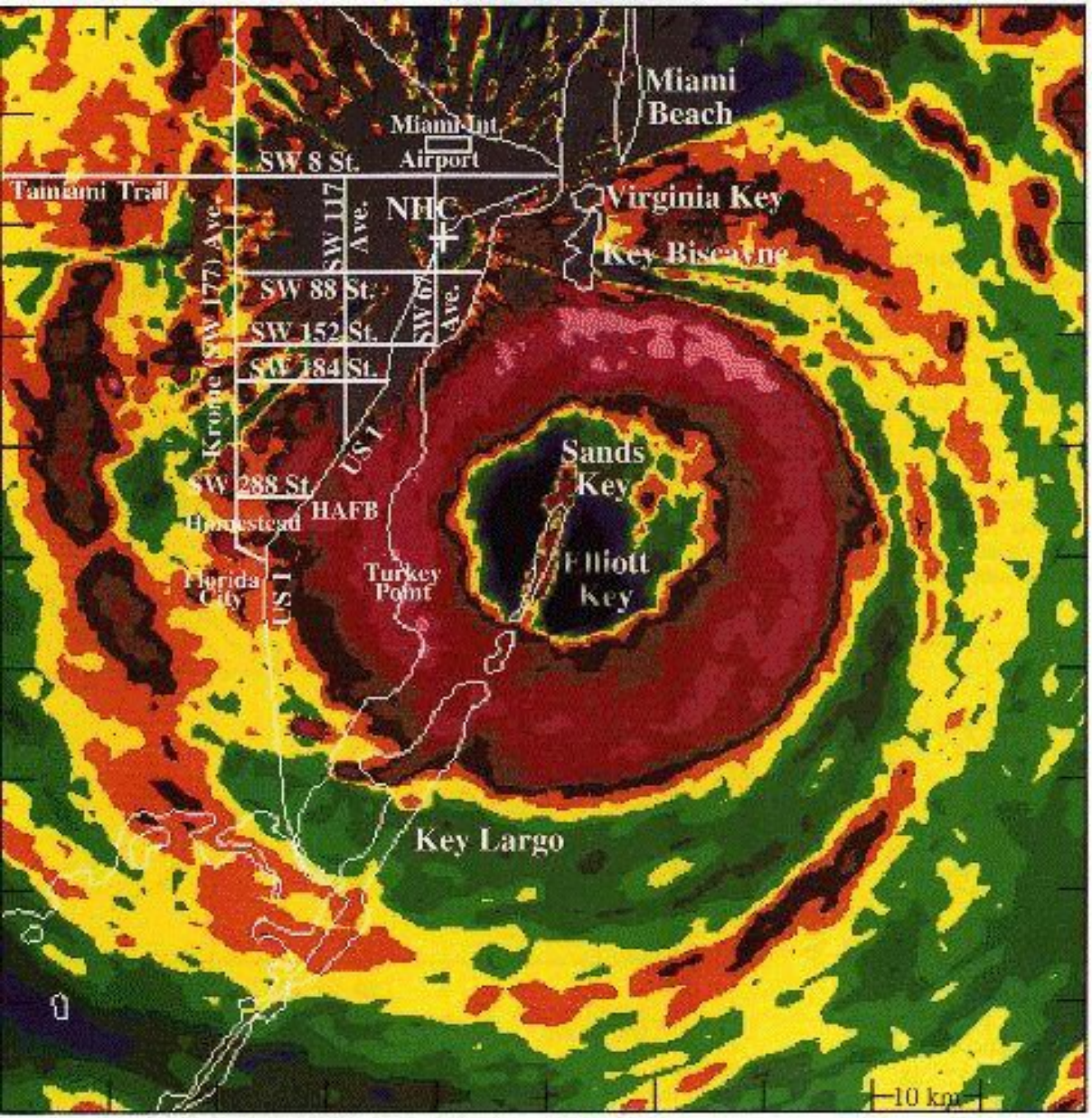

Tropical Features
30N
20N
15N
10N
5N
135E
140E
145E

A 4:1 MSI 17JUL97 1715 1000 x 866 13N
Tropical Features


TROPICAL STORM CESAR 17:45
Tropical Features
NOAA
GOES-8 VISIBLE IMAGE 7/26/1996

Hurricane Andrew
NOAA
Tropical Features
NOAA-11 Visible
August 23, 1992
12:31 UTC


Hurricane Andrew
NOAA
NOAA-11
Color Enhanced IR
August 23, 1992 12:31 UTC
Tropic
al
Featur



HURRICANE ANDREW

NWS MIAMI RADAR
August 24, 1992
08:35 UTC 04:35 EDT

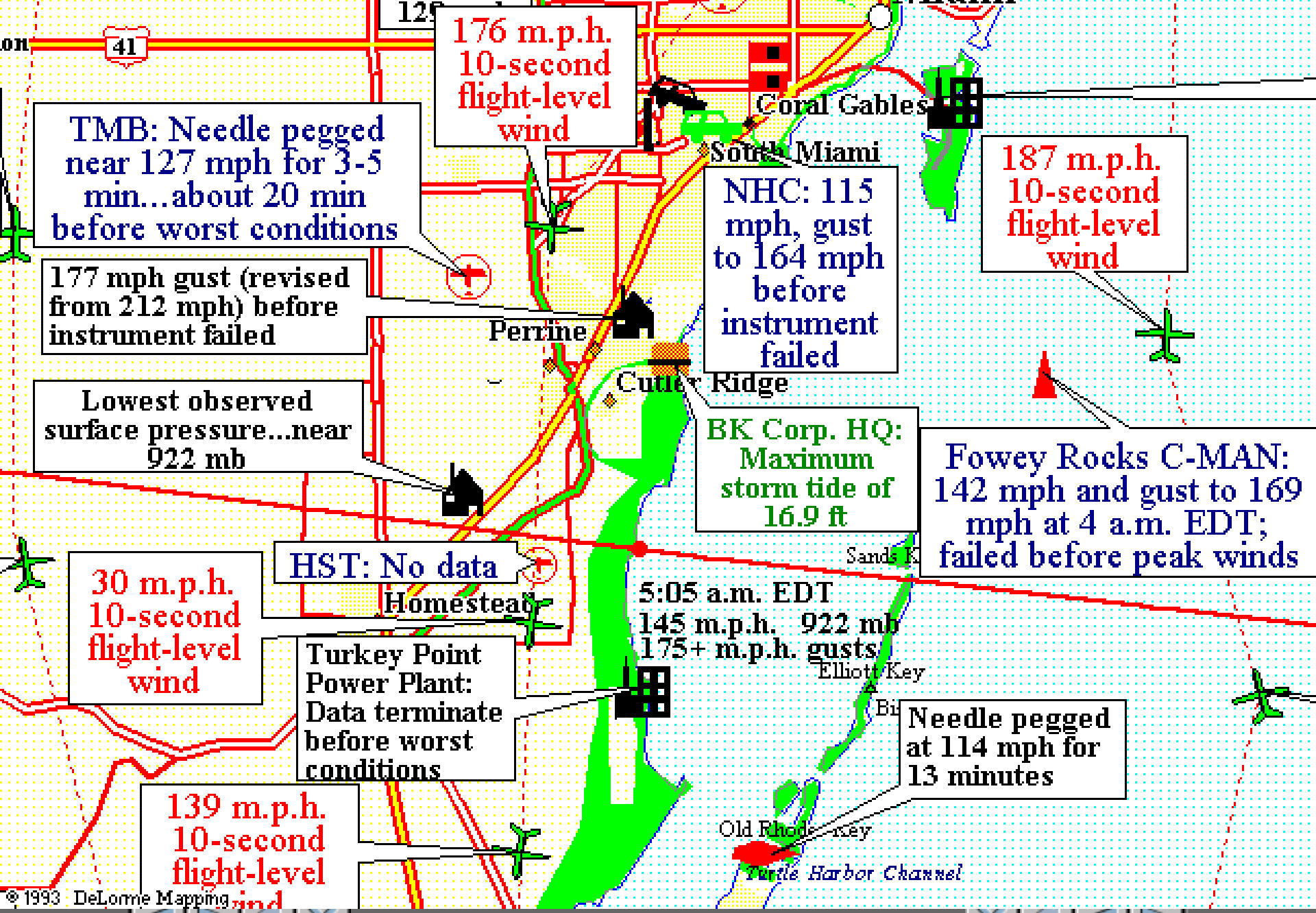
dBZ

> 48
48
45
42
40
37
34
31
29
26
23
20
18
15
< 15

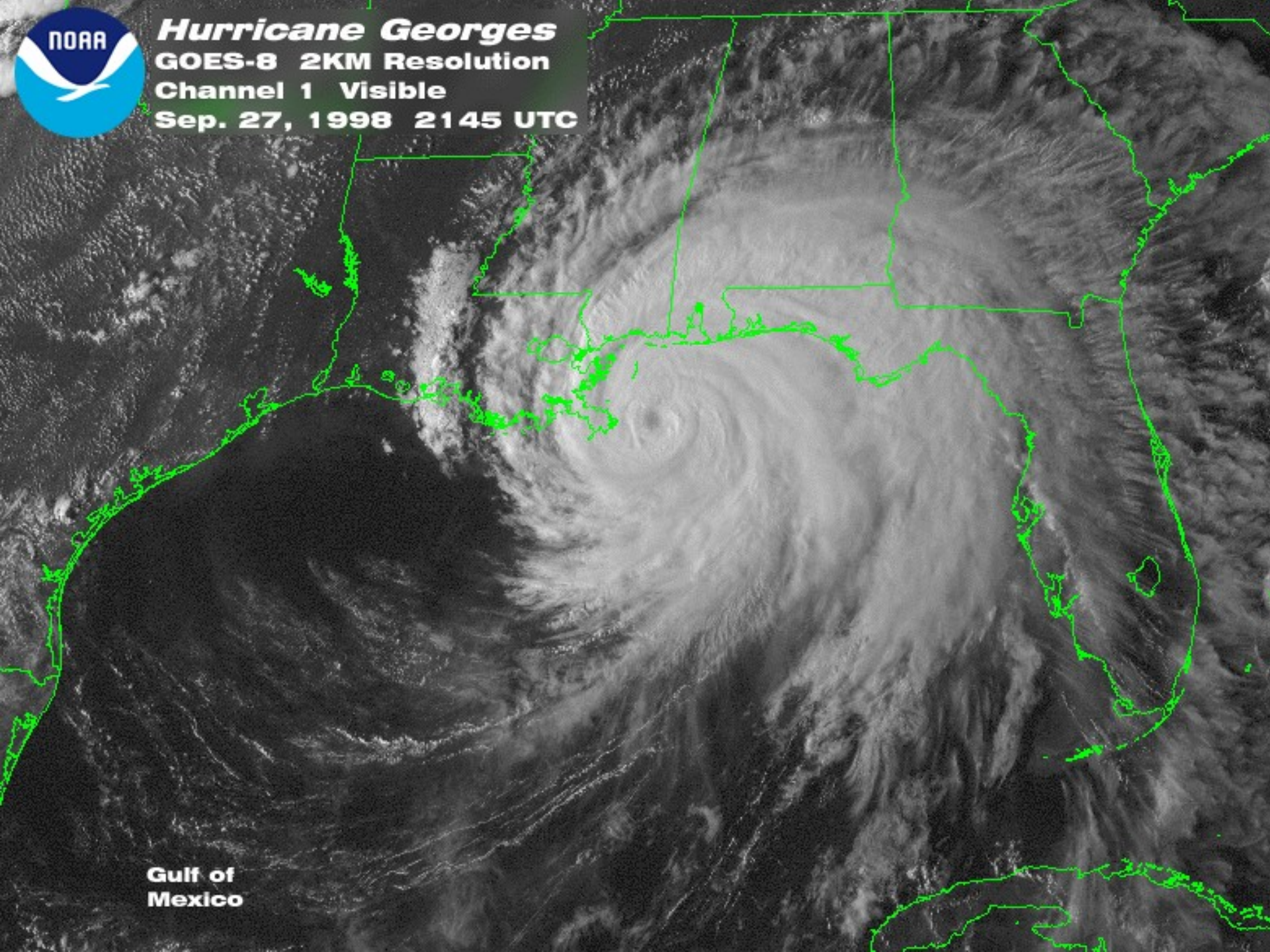
Hurricane Research Division

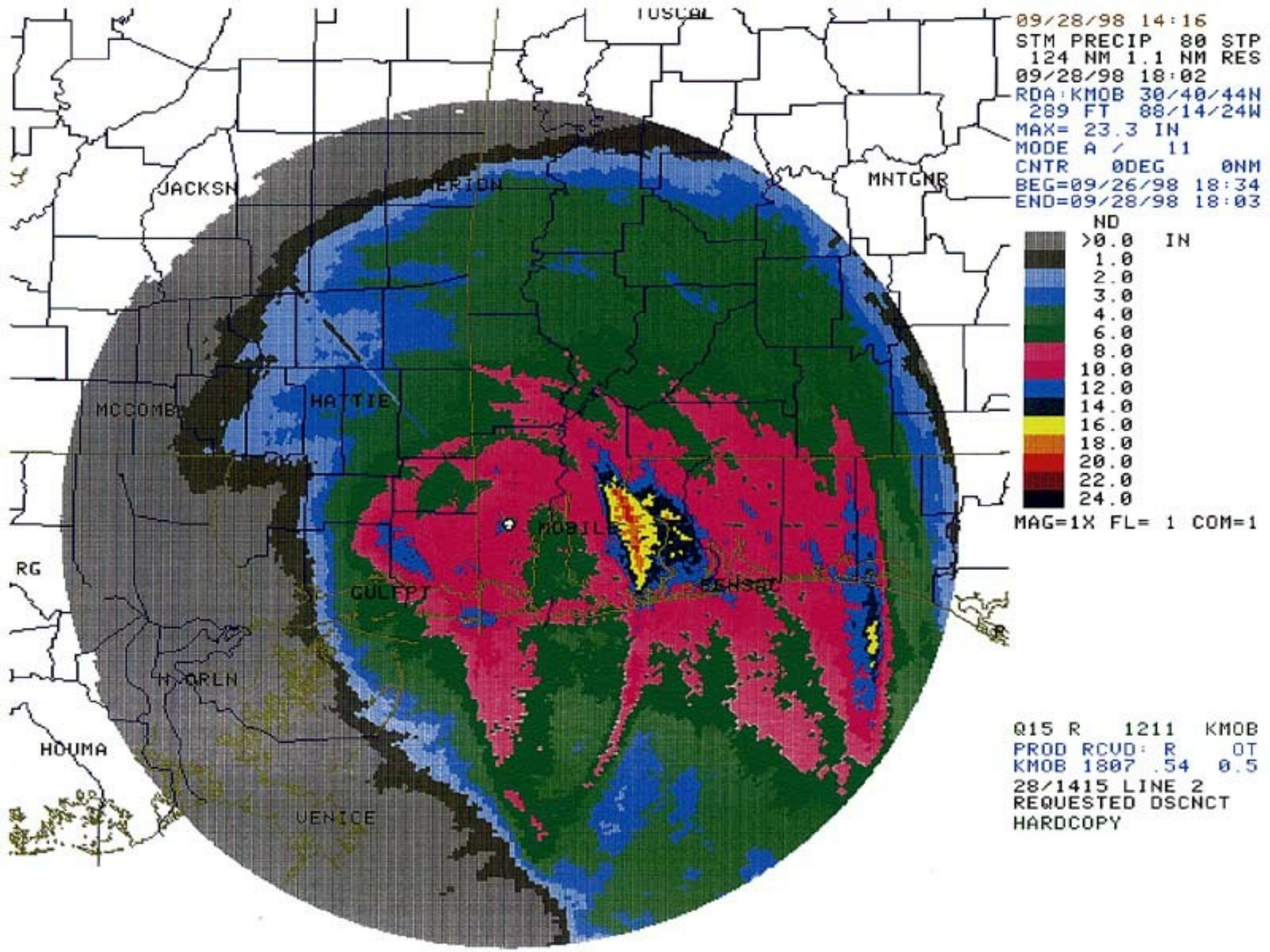
NOAA/AOML
Miami, FL

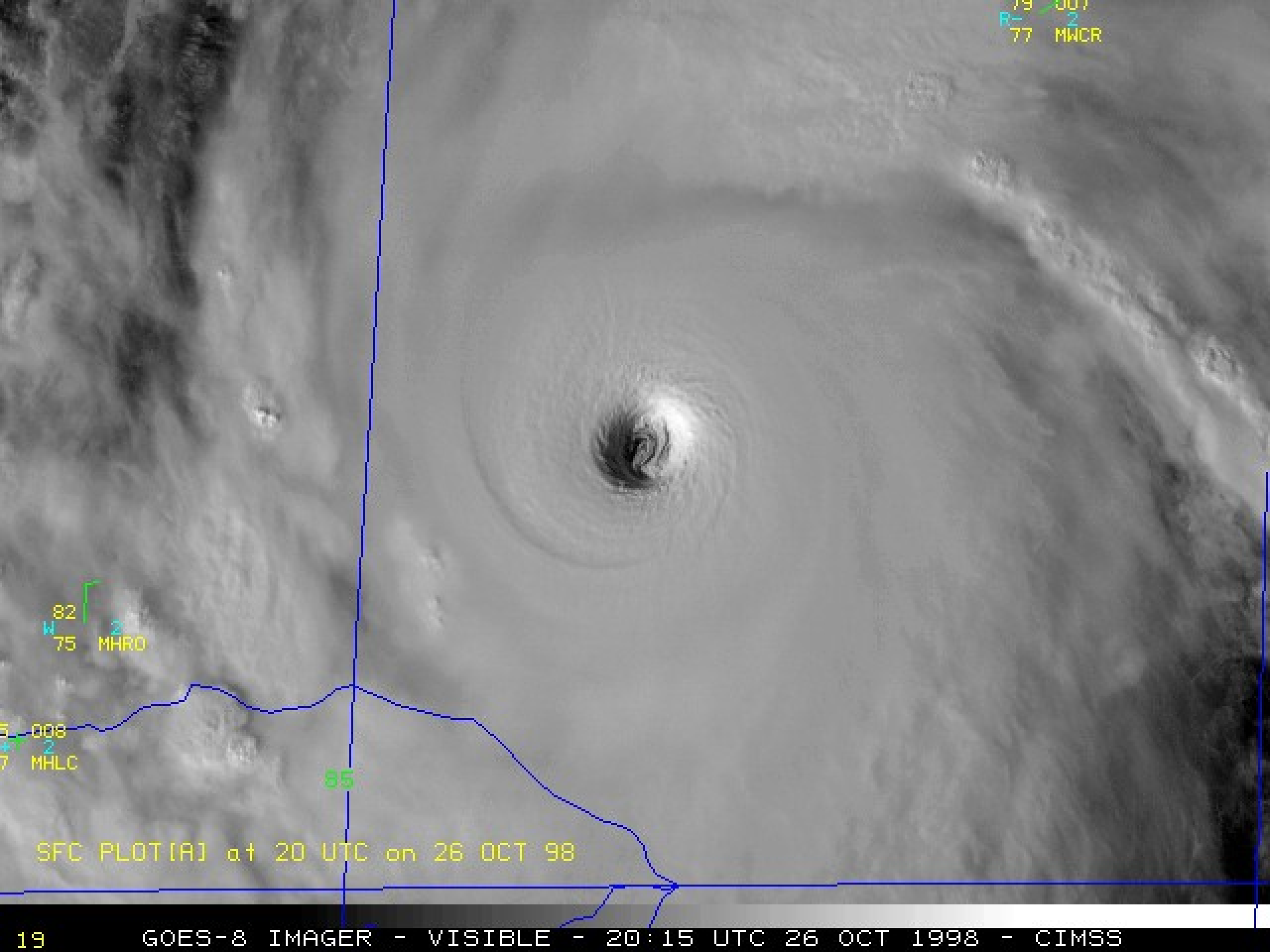
Domain: 100 x 100 km

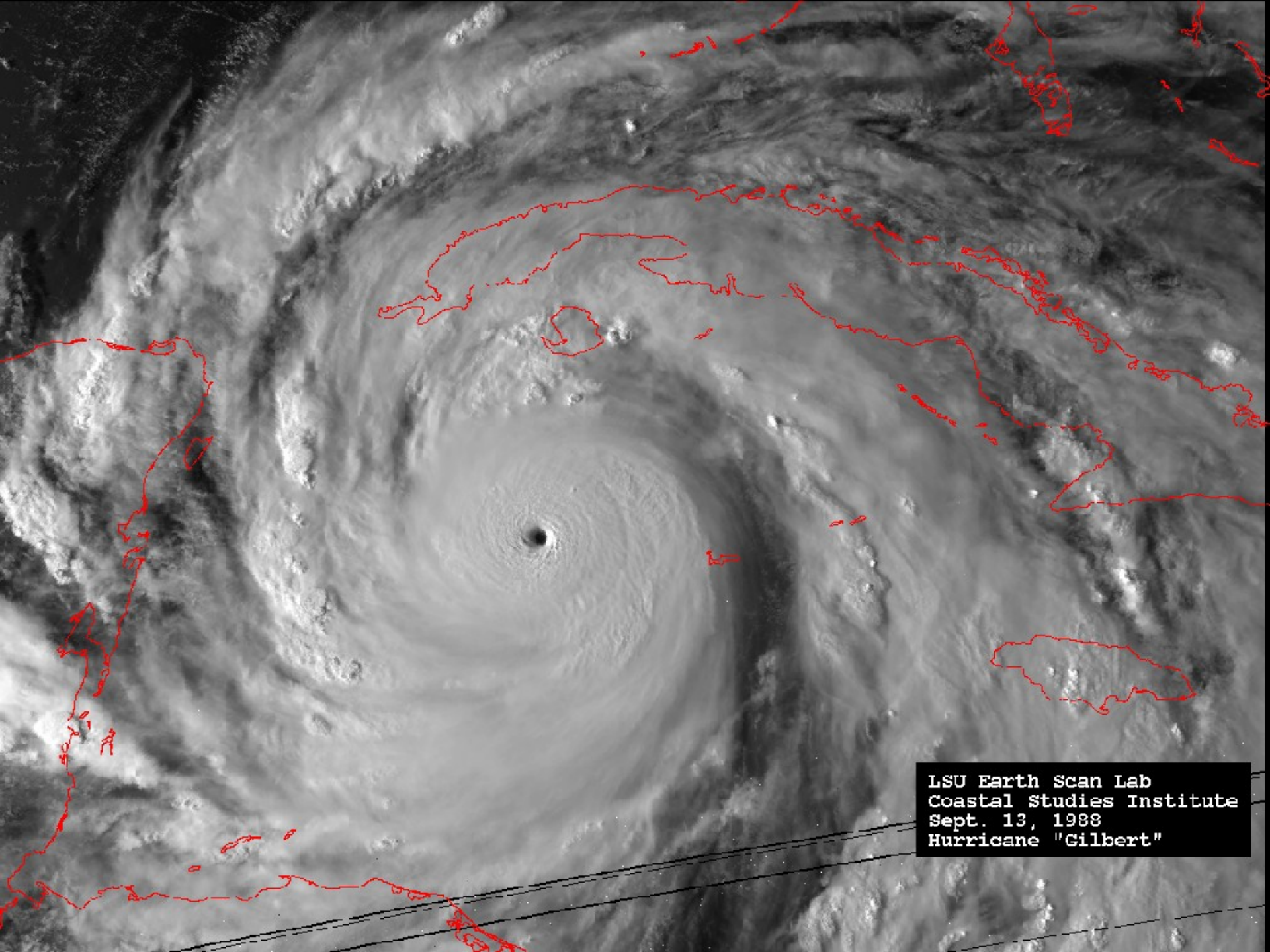

176 m.p.h. 10-second flight-level wind
TMB: Needle pegged near 127 mph for 3-5 min...about 20 min before worst conditions
177 mph gust (revised from 212 mph) before instrument failed
Lowest observed surface pressure...near 922 mb
30 m.p.h. 10-second flight-level wind
HST: No data
Turkey Point Power Plant: Data terminate before worst conditions
139 m.p.h. 10-second flight-level wind
NHC: 115 mph, gust to 164 mph before instrument failed
187 m.p.h. 10-second flight-level wind
BK Corp. HQ: Maximum storm tide of 16.9 ft
Fowey Rocks C-MAN: 142 mph and gust to 169 mph at 4 a.m. EDT; failed before peak winds
5:05 a.m. EDT
145 m.p.h. 922 mb
175+ m.p.h. gusts
Needle pegged at 114 mph for 13 minutes
Coral Gables
South Miami
Perrine
Cutler Ridge
Homestead
Elliott Key
Turtle Harbor Channel
41
© 1993 DeLorme Mapping

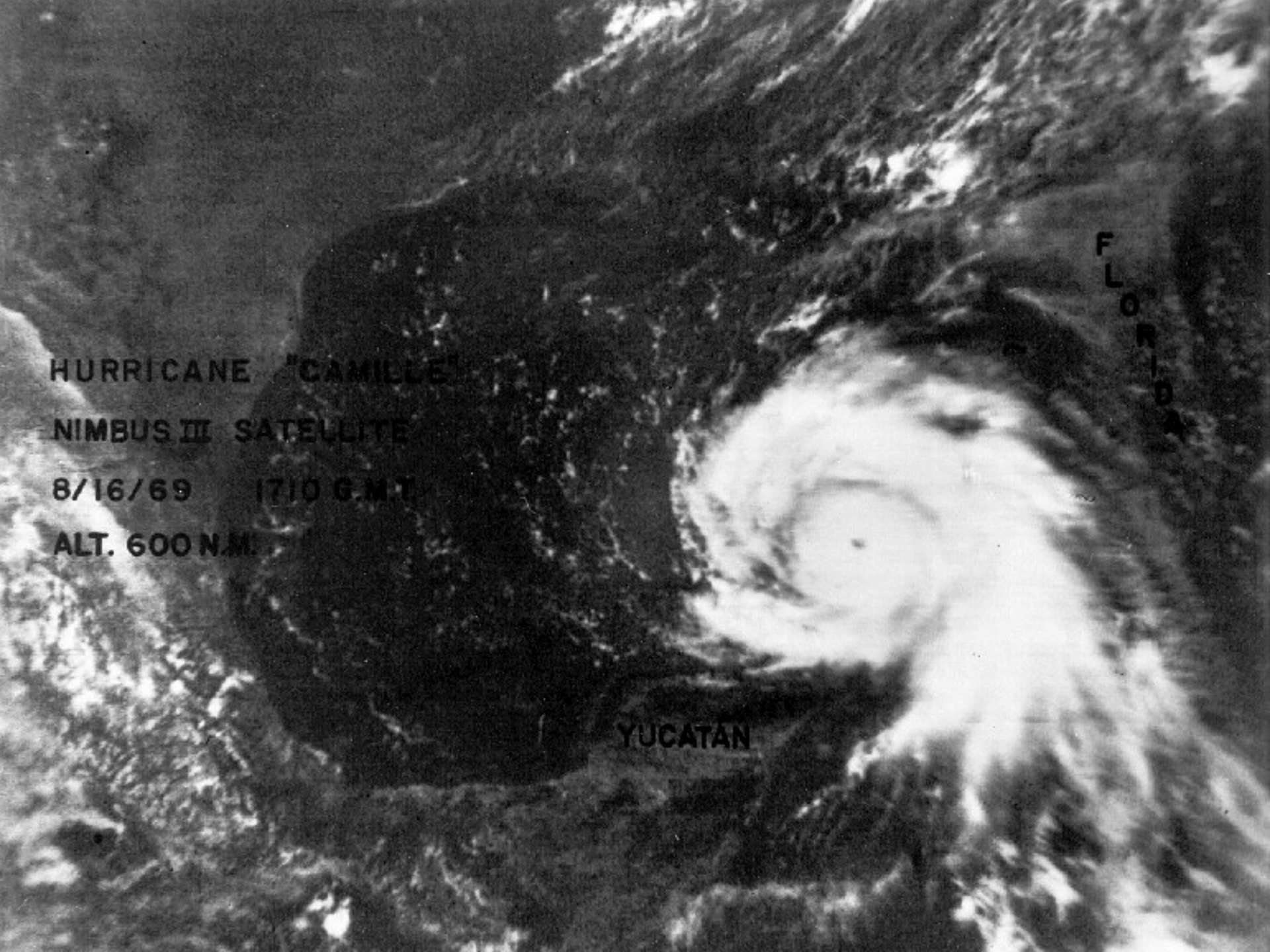
Determine Meteorological Features on February 20

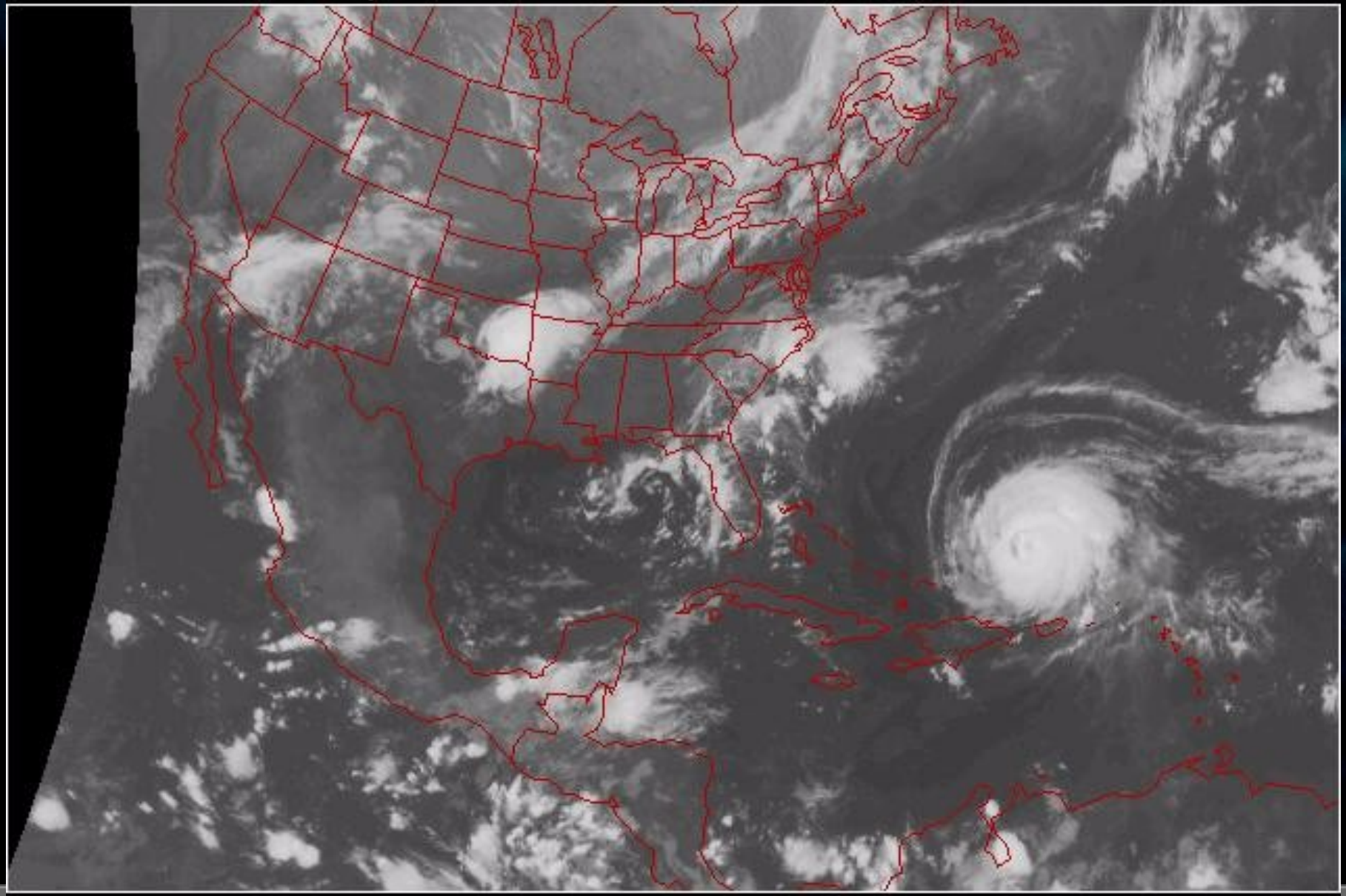

NOAA
Hurricane Georges
GOES-8 2KM Resolution
Channel 1 Visible
Sep. 27, 1998 2145 UTC
Gulf of
Mexico

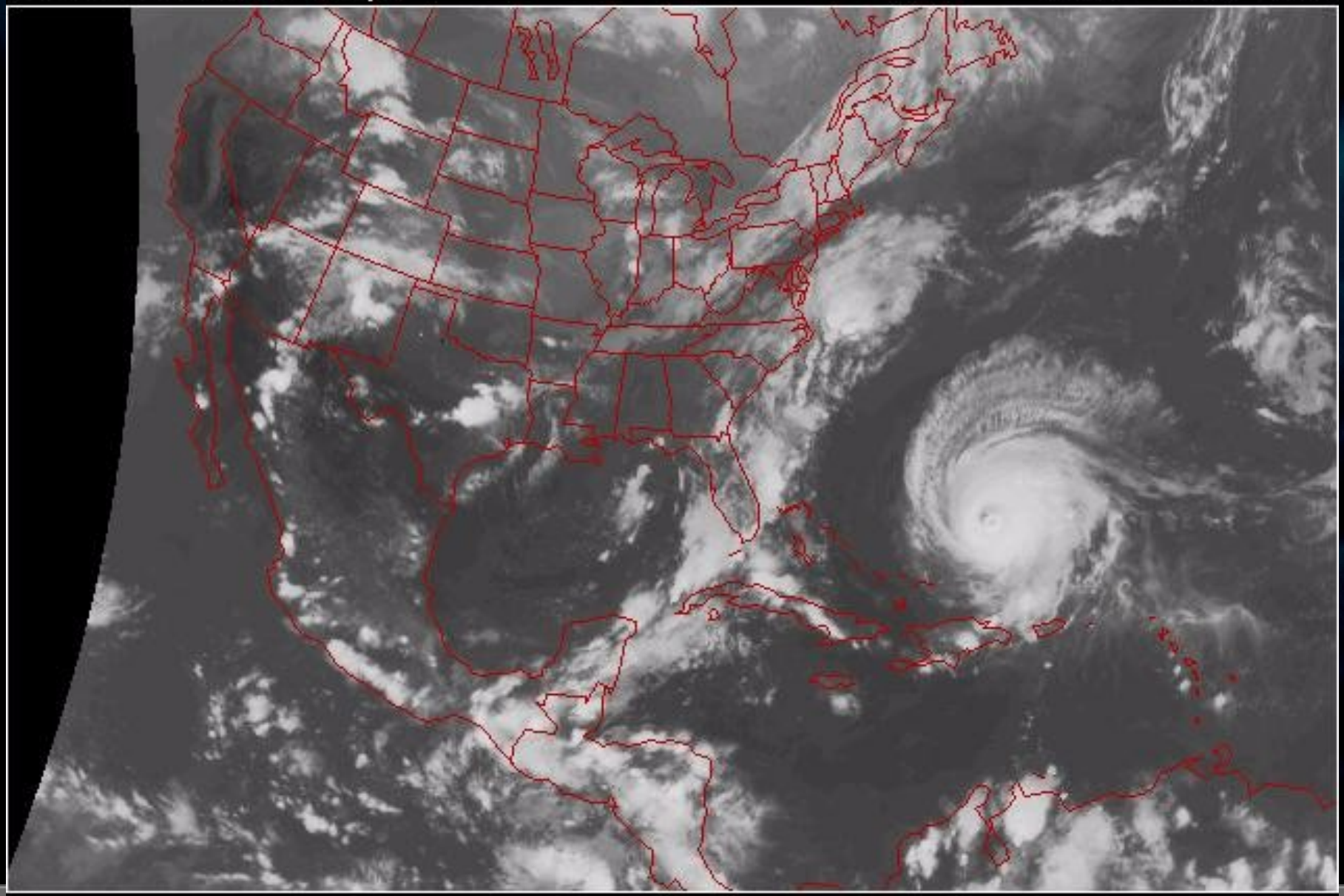

09/28/98 14:16
STM PRECIP 80 STP
124 NM 1.1 NM RES
09/28/98 18:02
RDA:KMOB 30/40/44N
289 FT 88/14/24W
MAX= 23.3 IN
MODE A / 11
CNTR 0DEG 0NM
BEG=09/26/98 18:34
END=09/28/98 18:03
ND
>0.0 IN
1.0
2.0
3.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
22.0
24.0
MAG=1X FL= 1 COM=1
Q15 R 1211 KMOB
PROD RCVD: R OT
KMOB 1807 .54 0.5
28/1415 LINE 2
REQUESTED DSCNCT
HARDCOPY
JACKSN
MERION
MNTGNR
MCCOMB
HATTIE
MOBIL
RG
GULFPT
PENSAC
H ORLN
HOUMA
VENICE

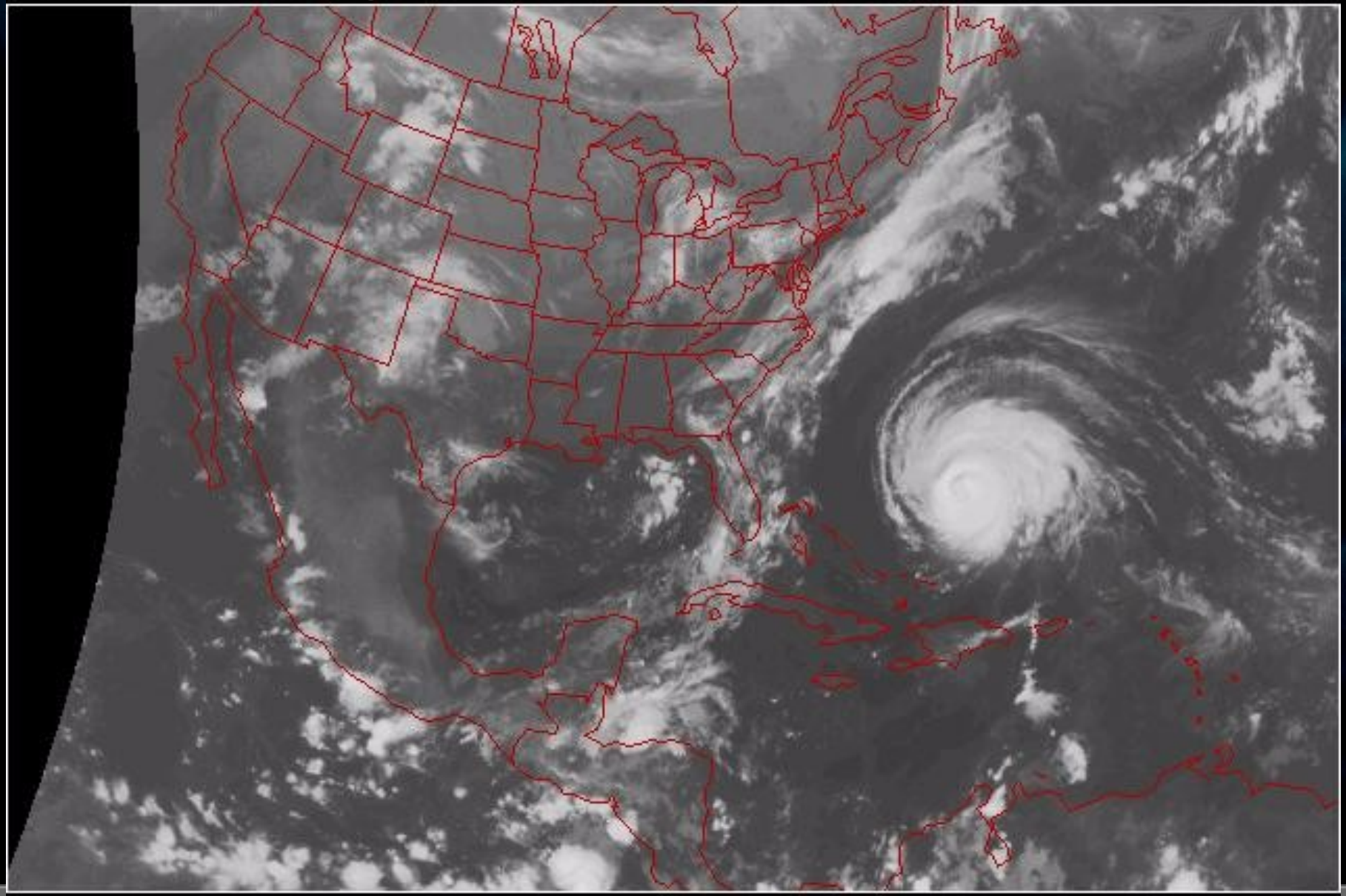

79 007
77 MWCR
82
W 75 MHRO
008
MHLC
85
SFC PLOT[A] at 20 UTC on 26 OCT 98
19 GOES-8 IMAGER - VISIBLE - 20:15 UTC 26 OCT 1998 - CIMSS


LSU Earth Scan Lab
Coastal Studies Institute
Sept. 13, 1988
Hurricane "Gilbert"


HURRICANE "CAMILLE"
NIMBUS III SATELLITE
8/16/69 1710 G.M.T.
ALT. 600 N.M.
YUCATAN
FLORIDA


GOES East Infrared Image
1215Z 7 SEP 1995


GOES East Infrared Image
0015Z 8 SEP 1995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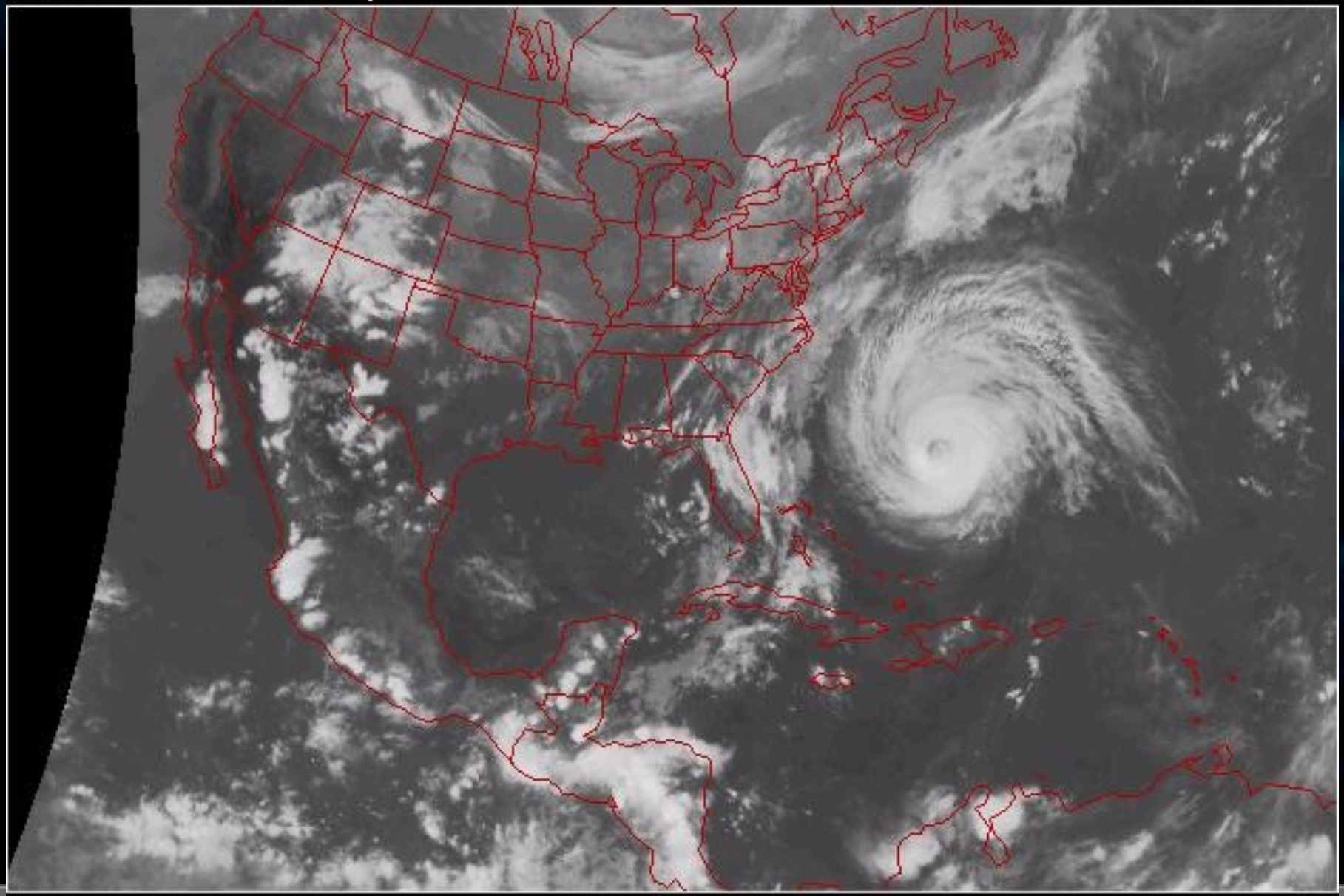
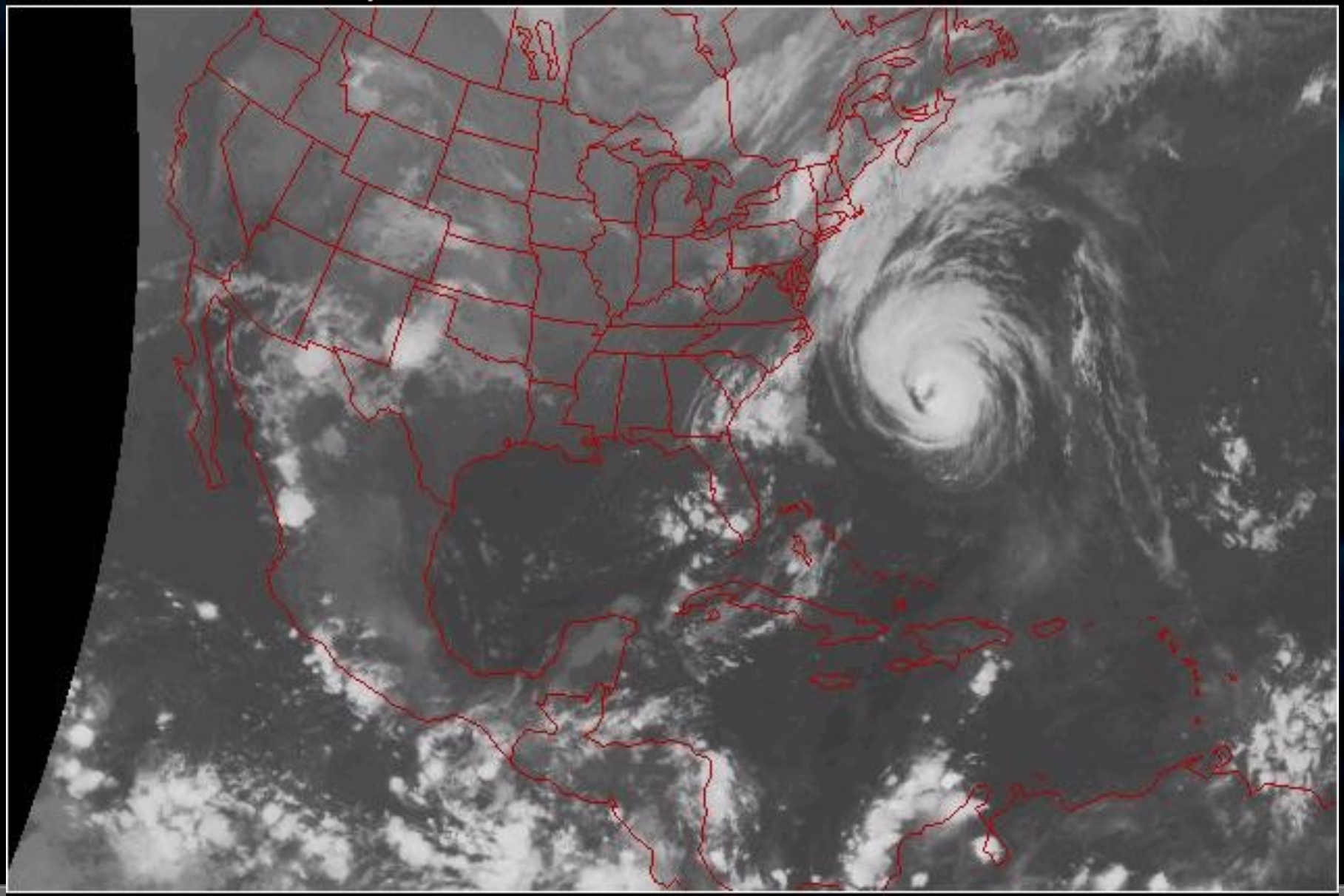

GOES East Infrared Image
0015Z 9 SEP 1995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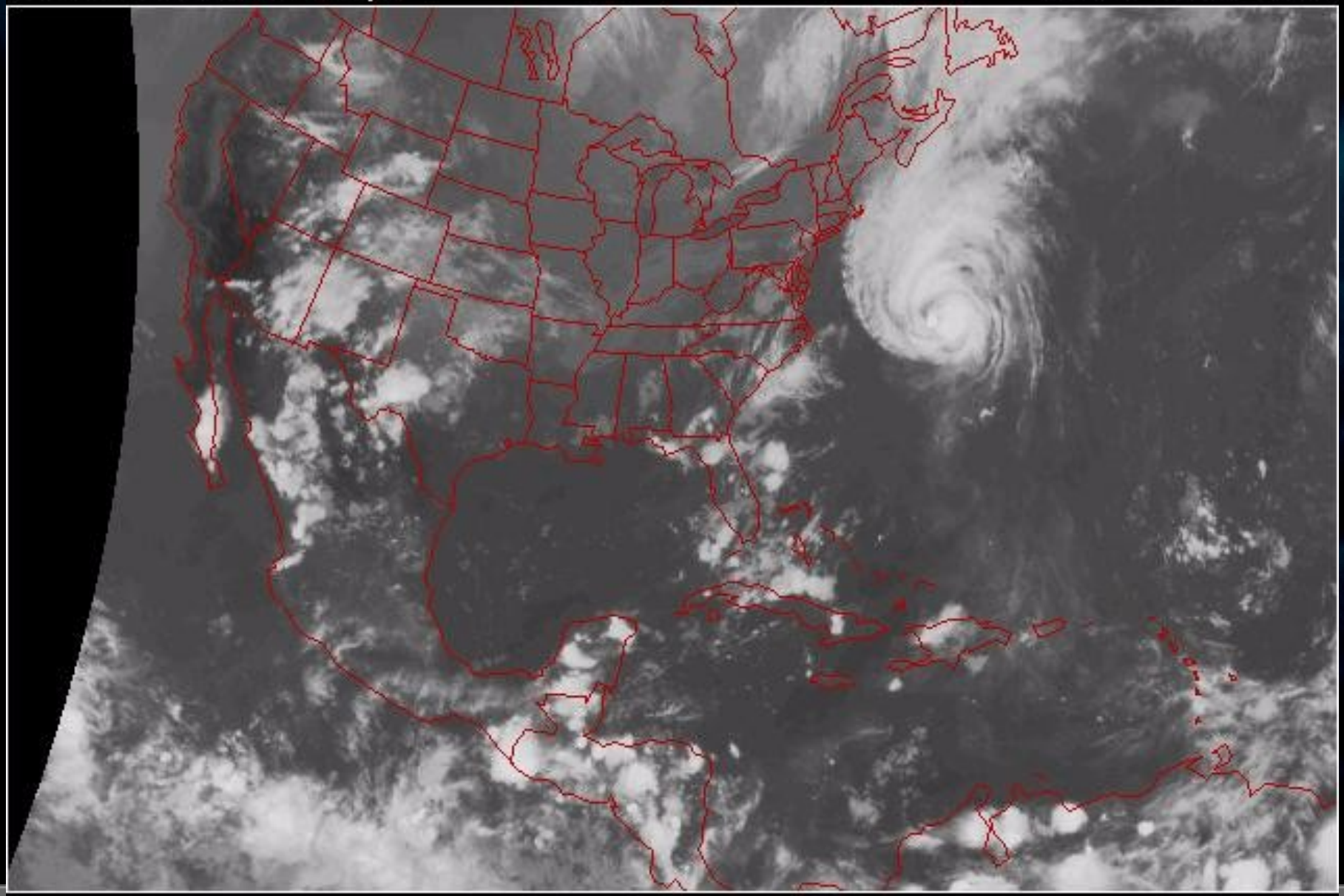
1215Z 9 SEP 1995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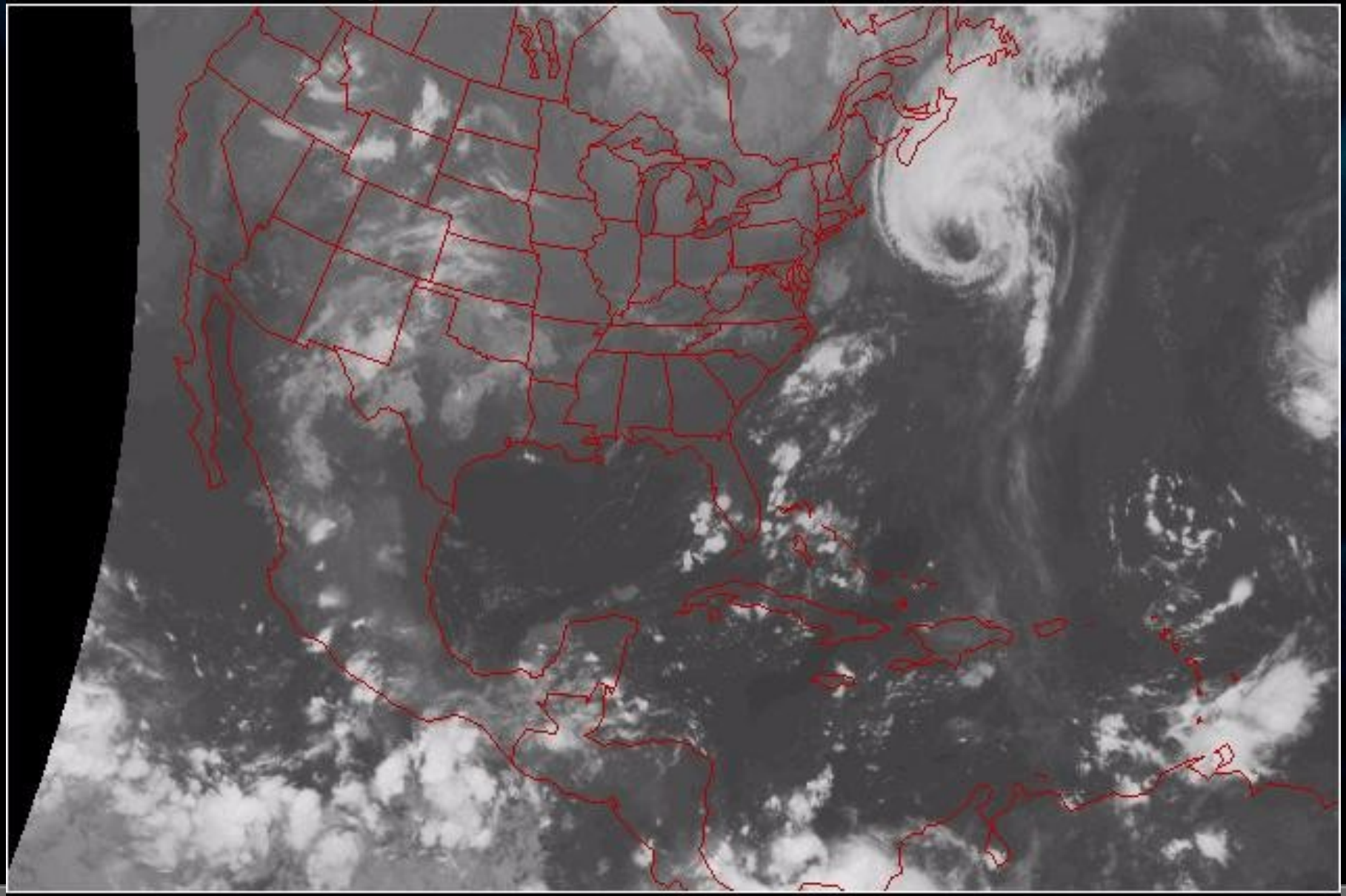
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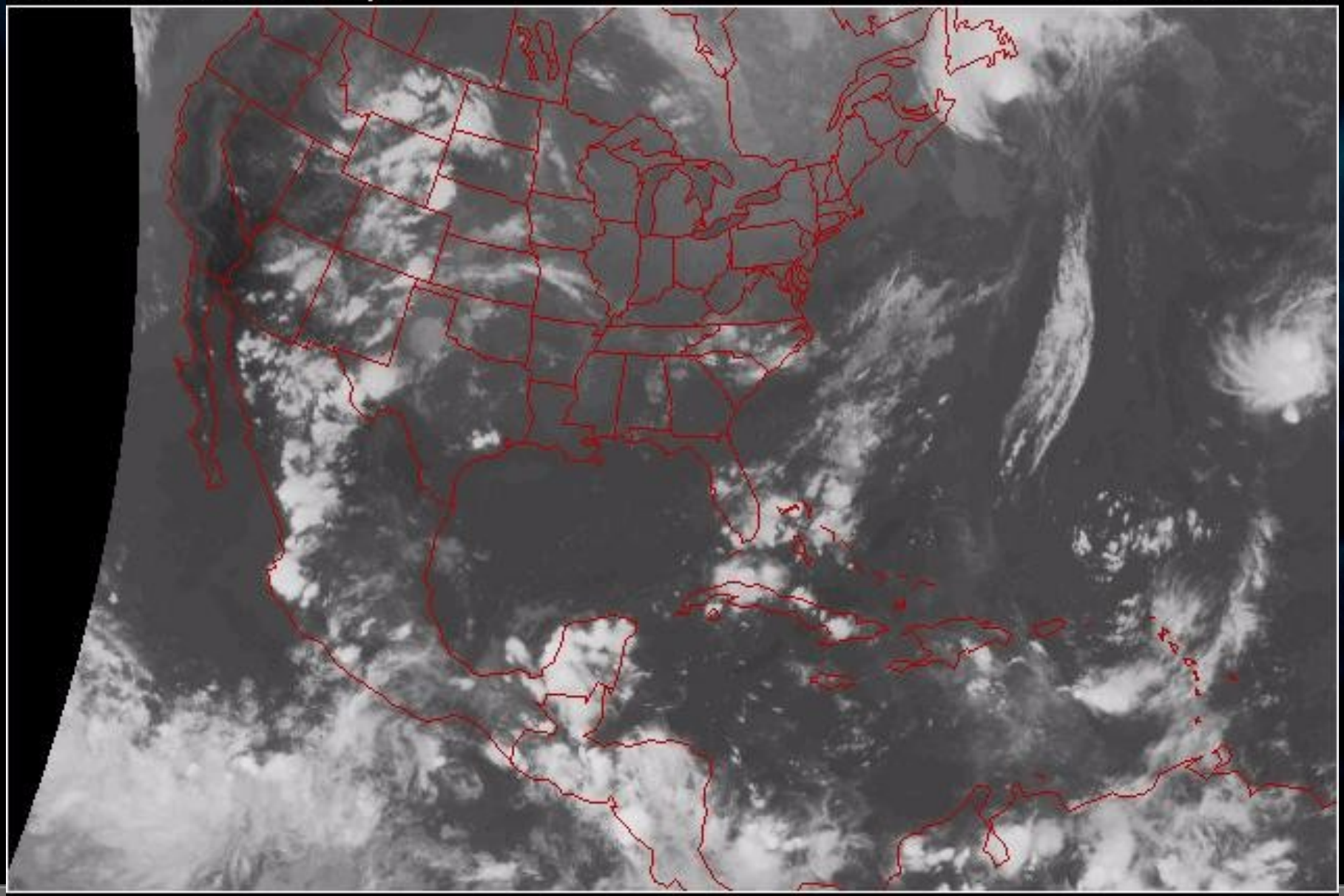
GOES East Infrared Image
0015Z 11 SEP 1995

- APPLICATION: Assign Review Exercise 3.

- EVALUATION: Administer and evaluate Appraisal 302c. Give the Written Test at the end of the unit.